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Abram S. Hewitt's Cataclysm.

A very prominent and wealthy citizen, an iron manufacturer and a man of affairs, Abram S. Hewitt, made some remarks in a public address a few days ago that were rather startling and which, had they been made by a different or a differently circumstanced man, might have been by most people dismissed as the ravings of a disordered intellect or as an attempt to "excite class hatred"; but, as it is, the remarks referred to are reverberating through the press and are being commented upon a great deal. It is quite unusual for a man of Mr. Hewitt's stamp and environment to lay upon the rich the blame for actual or supposedly impending social upheavals, and as Mr. Hewitt unequivocally does this his remarks naturally attract attention. Among other things he said:

"I believe that in the twentieth century, which is now near its dawn, the spirit of commercialism will steadily grow less strong and the spirit of altruism stronger. I believe that the rule 'do unto others as you would have others do unto you' will more generally prevail than in all the centuries which have gone before.

"If I am mistaken in this—if the spirit of commercialism and greed continues to grow stronger—then the twentieth century will witness a social cataclysm unparalleled in history. It is only by the discountenancing of commercialism and the spreading of altruism that we can safeguard justice, property, and liberty."

He expressed the idea that only by edution could the evils to which he referred be averted, and arraigned rich people severely for not giving more generally and more liberally to educational work.

It may seem rash to differ entirely from such a man as Mr. Hewitt on such a matter, but nevertheless we fully believe that if any such crash of the social structure does impend it is not to be averted by the generosity of the rich, but rather by the more complete reign of justice, and a better and more general understanding of the vital differences between monopolies and competitive business enterprises.

It is our belief that rich men can do far more effective work to avoid the catastrophe referred to by Mr. Hewitt by themselves discriminating between legitimate business enterprises and unfair monopolies and joining in the fight against the latter than they can hope to do by any amount of money-giving for the support of general education. One of the principal difficulties of the situation, it seems to us, is that leading men of influence—men of affairs, whose judgment is respected and who are at the head of, or at least largely interested in, perfectly legitimate and strictly competitive business enterprises—allow themselves to be classed in the popular mind with the monopolies that are really working mischief.

Business men somehow seem to feel that the masses of the people do not discriminate between unfair monopolies that are really robbing the people and legitimate and competitive though large business enterprises, and too many of them make the mistake of condemning every criticism of monopolies, classing everything of the kind as "attacks upon wealth," "assaults upon vested interests" or "instigation to class hatred." We believe, however, that the great body of the people are fully capable of perceiving the difference between monopolies and fair business enterprises, and that nothing else can so promote this understanding on their part as it would be promoted by wealthy business men coming out boldly against unfair monopolies of all kinds and distinctly calling attention to the differences between them and competitive though mayhap large business enterprises.

No amount of mere money giving for educational or any other public, charitable or semi-charitable purposes can possibly do much good in such education of public opinion as must be done and could be most effectively and rapidly done by the assumption of such an attitude as we have indicated on the part of successful business men and manufacturers. Let those of them who do not enjoy any monopoly—and they are legion—persistently refuse to be identified or classed with the monopolies, and let them show by word and by deed that they are opposed to monopolies of all kinds and are ready to co-operate with every proper and honest effort to abate them.

What has the competing and honest manufacturer in common with the interests of such men as organized the infamous South Improvement Company, by which the supply of petroleum was practically corralled, many independent refiners utterly ruined and fortunes amassed which no man can possibly render to the community a fair equivalent for? What call have honest business men and manufacturers to defend or excuse the anthracite coal monopoly, which is maintained by railroads in practical violation of law and to the serious detriment of the equal right of human beings to live on earth and to make themselves as comfortable as possible while doing it?

Why should business men and manufacturers whose every dollar is made in the face of sharp competition feel themselves called upon to defend the operations of men of that ilk? Is it not clear that by refusing to do so and by encouraging every proper effort against such blood-sucking organizations, they can do far more to protect real and legitimate property rights than can be done by any amount of efforts at the "repression of commercialism" or the spread of altruistic ideas.

We believe in commercialism. We think the desire of men to make money in legitimate ways and to build up large business enterprises is a good thing, not only for the men who do these things but for the community as well. Mr. Hewitt may not think so, but his remarks are nevertheless

pervaded by the spirit of socialism pure and simple. They mean that rich men, regardless of how they may have become rich, should give largely to others who perhaps have no claim upon them whatever. We do not believe in that principle, but we do believe that every human being brought into the world ought to have an equal chance with every other human being to work and to enjoy the full fruits of his labor, and that it is the duty of leaders of thought and of government to see that whatever monopolies stand in the way of this should be destroyed. After that "cataclysms" and many other dreaded things will retire from the field and we shall be able to see more clearly what more needs to be done.

Technical Publications.

We have received from the Decimal Association, Botolph House, Eastcheap, London, E. C., a pamphlet entitled "The Metric System," which consists of a paper read by Mr. Rufus P. Williams, president of the New England Association of Chemistry Teachers, at a meeting of the American Chemical Society, June, 1900.

"The Gas Engine Handbook." By E. W. Roberts. 241 3½x5¼-inch pages, with 40 illustrations. Second enlarged edition. The Gas Engine Publishing Company, Cincinnati. Price, $1.50.

We are glad to notice the second edition of this useful little book, the first edition of which was noticed in our issue No. 17, of this year. So early an appearance of the second edition shows that it has been well received. The new matter is comprised in an appendix on the two-cycle engine.

"West's Molders' Text Boox." By Thos. D. West. 461 5x7¼-inch pages, with 146 illustrations. Eighth edition. Wiley & Sons, New York. Price, $2.50.

We are glad to notice the appearance of the eighth edition of Mr. West's book. Foundrymen will find it to contain just the sort of matter which they look for in a book on the operations connected with their work, while every page shows that it has been written by one who is familiar with every detail of the foundry. Its continued sale is the best evidence of the favor in which it is held. We are bound to say, however, that the expectations regarding the extent of the revision which one forms when reading the preface, are barely fulfilled when the old and new editions are compared.

"Dynamo Electric Machinery: Direct Current Machines." By Samuel Sheldon. 281 5½x7½-inch pages, with 202 illustrations. D. Van Nostrand Company, New York. Price, $2.50.

This book, according to the preface, is intended primarily for use in engineering schools, but is designed to be equally adapted to the needs of the general reader. It is certainly well fitted to the second class of readers, although it is in no sense an elementary or popular book, in the ordinary meaning of these terms. Of all books on the subject which are within the engineering grade, this makes a less burdensome use of mathematics than any which we recall—in fact, it is not easy to see how this could be reduced in amount below what is given. The leading types of direct-current dynamos and motors are fully discussed in language which, while strictly scientific and exact, can yet be read by anyone who will make the serious attempt which is always necessary in reading matter of this character. Perhaps the most generally useful chapter of the book is that on design, in which the various steps of the process are clearly explained.

Engineering Association of the South

The eleventh annual meeting of the Engineering Association of the South was held the evening of November 8 at 74 Fourth street, Nashville, Tenn. There were present a large number of members, including several from a distance. The ballot for officers resulted in the election of the following: President, Maj. Niles Meriwether, Memphis, Tenn.; first vice-president, W. H. Schuerman, Nashville, Tenn.; second vice-president, G. M. Ingram, Nashville, Tenn.; secretary and treasurer, H. M. Jones, Nashville, Tenn.; resident directors, James Geddes, E. C. Lewis and R. T. Creighton; directors from membership at large: G. F. Blackie, Mt. Pleasant, Tenn.; G. D. Fitzhugh, Birmingham, Ala.; E. E. Betts, Chattanooga, Tenn., and C. S. Brown, Nashville, Tenn.

The secretary showed in his annual report that the condition of affairs was encouraging. During the year closing thirty-two new members were added. The active membership list now exceeds 100. The financial statement showed a surplus of $215, with all obligations paid. A proposed amendment to the constitution authorizing the establishment of local sections was brought up for discussion. The members of Birmingham, Ala., who will establish a section when the amendment has been adopted, were represented by a committee of three, who came to present some amendments to this amendment. It was by a unanimous vote amended as proposed. The idea in this step is to allow engineers in various localities to organize for the purpose of holding local meetings for the reading and discussion of papers, and establishing headquarters and library locally, if they desire. It seems that in this manner the association may be able to reach far more engineers and thereby extend its usefulness.

After business, the members were served with refreshments. While the gentlemen were enjoying their cigars, President Geddes presented his annual address. It was a review of the beginning of the surveys and construction of the Louisville & Nashville Railroad, in which company's service Major Geddes has been since the fifties. He told of the early engineers and their work, and of the difficulties with which they had to contend.

New Automatic Recording Machine

Mr. E. C. Oliver, of the mechanical engineering department of the University of Illinois, has just succeeded in perfecting an automatic recording machine.

For several years Mr. Oliver has been at work under the advice of Professor Breckenridge on a machine which would record automatically different lines of data with regard to the speed and power of engines. He has at last designed and constructed this universal recorder, which can be applied to either gas or steam engine or to a dynamometer car, and which is capable of taking any one or all of eight readings by means of ink tubes passed over an endless roll of paper. The ink tubes are attached to the armatures of electro-magnets and these magnets are electrically connected with the different parts of the engine to be tested and are actuated by the electric current. The recorder gives faithfully the speed of the engine, the number of the horse-power exerted, the rate of the occurrence of the explosions and the number of revolutions per minute of a gas engine. The machine is very carefully worked out and should prove of great value in experimental as well as practical work.

C., B. & Q. Locomotives.

The management of the Chicago, Burlington & Quincy Railroad has contracted with the Baldwin Locomotive Works for thirty more new freight engines, to be delivered next March. They will be alike in construction, each having three pairs of drivers and a set of leading and trailing trucks. The driving wheels will measure 64 inches in diameter and the truck wheel 37 inches in diameter. The dimensions of the cylinders will be 24 by 24 inches. The engines will differ from the average freight train puller in having wider and shorter fireboxes. The fireboxes will be 7 feet long and 6 feet wide, and their heating surface, combined with that of the tubes, will be about 2,498 square feet. The weight of each engine on its drivers will be 120,000 pounds. The leading trucks will weigh 16,000 pounds and the trailing trucks 24,000 pounds. Unloaded, each tender will weigh about 38,000 pounds. It will have a capacity of 5,000 gallons of water and between 9 and 10 tons of coal.

It is announced that the present is the last week of the Rogers Locomotive Works at Paterson, N. J., as no parties have been found who will accept the terms of Jacob S. Rogers, the principal owner. Orders are being turned away, going mostly to the Baldwin Works. It is stated that the profits of the business for the past year were $175,000.

Commercial Review.

NEW YORK, Saturday, December 1.

MACHINE TOOLS AND OTHER MACHINERY.

The outlook from New York for the machine-tool trade is conservatively favorable. While there is not the boom that some looked for, trade of an ordinary sort runs along in a very fair way. Trade of an extraordinary sort, however, bids fair to swell the total of orders. There are several very large deals pending or recently closed. One of these—that of the W. R. Trigg Company, shipbuilders, of Richmond, Va., which came through this market and which was mentioned in last week's report was in the neighborhood of $100,000. Some good-sized contracts have been let for tools to go in the equipment of the new Lozier gasoline motor works at Plattsburg, N. Y. A large portion of these was placed through the Prentiss Tool and Supply Company, New York, and the Marshall & Huschart Machinery Company, of Chicago, had a share. Three turret lathes of the American Turret Lathe Company were contracted for also.

Yet the most interesting transaction of all is the receipt of estimates on machine tools for the new British Westinghouse works. A representative of that concern is now in America and specifications are being given out and bids put in. It is judged that the amount of the purchases all told will run into the hundreds of thousands of dollars. Their magnitude is indicated by the fact that some 160 or 170 lathes are called for and these extend as high as 125 inches swing.

The proposals for machine tools for the Rock Island (Ill.) arsenal—a government purchase of unusual size in its line—which were opened a few weeks ago, have been acted upon by the local authorities in the way of recommendation, and have been sent to Washington for approval. A New York tool man whose company feels assured that it will receive a good share of the distributed favors was in Washington yesterday with reference to the business.

The United States Machinery Building at the Vincennes department of the Paris Exposition has been sold through Charles Neat & Co., London, and will be taken down and re-erected in the north of England. With the building go the engine, boilers, dynamo, 30-ton traveling crane and the rest of the electric plant and other accessories. It is understood that the purchasers will fill it with the latest American machinery, for which orders are to be placed in due course. The buyers do not want their name to appear in connection with the transaction, since they are English people and feel that they would be called unpatriotic by their countrymen.

The American Turret Lathe Company, Wilmington, Del., has opened an office at 133 Liberty street, New York City, and has installed one of its 24-inch semi-automatic turret lathes which in a short time will be set running with an attendant constantly on hand to demonsrate its operation. An office will also be opened in Boston in the near future. These will be in charge of J. W. Cregar, proprietor of the Machinery Sales Agency at the Bourse, Philadelphia, and who for about two years past has also been managing the New York office of the Pratt & Whitney Company. Mr. Cregar has the exclusive sale of the product of the American Turret Lathe Works for New England, New York, New Jersey, Delaware, Pennsylvania, Maryland and Virginia.

Recent developments of trade from Mr. Cregar's standpoint give a hopeful view of the state of the tool market. Sales at the store at the Bourse for the last two weeks have been heavy and show considerable improvement over times previous. In the last five weeks he has sold seventeen of the American Turret Lathe Company's machines, including those for the Lozier works above noted, and yesterday an order was closed for eight automatic turret lathes of the same make, to go to an established concern in the West and be used in making duplicate parts for engines, motors, etc.

The Cumberland Iron and Steel Shafting Company, Cumberland, Md., reports a general awakening in the demand for shafting. This factory does a large foreign as well as domestic business, and states that both are increasing. The recent enlargement of the shops enables it to cope with its expectations, and if prices can be steadied prosperity of goodly proportions can be looked for.

We have received a prospectus of an industrial exchange, or "Centro Industrial," the establishment of which is proposed by Van de Velde y Cia., 3er Independencia No. 2 (or post-office box 1 B), Mexico City, D. F. This is an association open to not more than 50 subscribers of $10 or $15 gold per month, no two competing firms being allowed to subscribe. The benefits offered by the exchange are reports on special lines of business, credit reports, legal advice, collections, mailing letters and circulars, desk and exhibition room, recommendations of representatives, interpreters and canvassers, attention to translation, printing, advertising, shipping, etc. The New York representative of this enterprise is Isador W. Teschner, 154 World Building, New York. The Mexican market is now such a lucrative one that this "Centro Industrial" ought to be useful and successful if managed rightly.

PITTSBURGH REPORT.

The tendency on the part of buyers to hesitate and take to cover on every stray wind did not last long in its severity and at the present writing one sees more buyers and transactions not so limited in their size, although there is still much room in which to increase. There was somewhat a scare caused by the announcement that the Valley Bessemer furnace men were going to advance prices to $14 per ton at furnace. This contemplated increase has been postponed until after the first of the year. Some large sales of Bessemer have lately been made at $13.25 and $13.50 at Valley furnaces.

The market can be generally spoken of as being in fairly good condition. Inquiries are coming in with more rapidity and are for larger quantities than has heretofore been the rule. The trend appears upward, although it is more a mere indication than an actual fact so far. It is the rule now to withhold quotations for next year's business, especially in the finished lines, while in the raw materials there is not much inquiry going.

Structural material has been in good demand for the past week. Concerns which were awaiting the result of the election are now figuring on enlarging their works and capacities so as to be in better shape to meet the demands of the customers. From all parts of the country are heard reports that foundries will install more cupolas, machine shops will add to the equipment, boiler and engine makers will increase their capacities and various other industries will make improvements so as to increase the output.

In nearly all cases it is the opinion that trade will increase gradually, and that by next spring there will be a good demand for all classes of manufactured goods. Furnace men believe that their side of the market will pull out all right if the demand for finished goods holds up, allowing the furnaces to begin the new year with clean yards and a fair demand.

The U. Baird Machinery Company, Pittsburgh, report a revived demand in their territory for all classes of machine tools. They have enlarged their offices and increased their repair shop on Twenty-fifth street and Liberty avenue. Hitherto, they have confined themselves to machine tools and supplies, but a recent sale made by them of traveling cranes places them in an additional field. They have just sold to the Chicago & Alton Railroad, for their new shops at Bloomington, Ill., two 60-ft. span travelers, each of 50 tons capacity and provided with six electric motors for main and auxiliary hoists; also one of 24 ft. span and one of 39 ft. span, having capacities of 25 tons, and provided with three motors each. These cranes are manufactured by the Case Manufacturing Company, of Columbus, Ohio.

The Pittsburgh Machine Tool Company, which has been in operating existence for only a year, has been hard hit by prosperity. The entire shop is working on lathes, and has been so busy that the manufacture of its line of planers has been postponed until the first convenient breathing spell. Orders are numerous and increasing, new machinery has been added and the shop wears a very crowded air. Lathes of 26-inch swing have recently been shipped to parties in Butler, Pa.;

Franklin, Pa.; Parkersburg, W. Va., and Pittsburgh, Pa. The Mesta Machine Company, of West Homestead, and Struthers, Wells & Co., of Warren, Pa., each take a 32-inch and a 26-inch lathe, and the Gleason Tool Company, of Rochester, gets a 38-inch lathe. In course of construction is a 60-inch lathe with special attachments for the Erie City Iron Works, of Erie, Pa. All the machinery in this shop is up to date, the latest addition being a Warner & Swasey hollow hexagon turret lathe.

Ott. Mergenthaler & Co., Baltimore, Md., are extremely busy in all departments. In the reamer department their facilities are taxed to meet a steadily increasing demand. In their contract department recent orders will keep them working overtime for some time to come. So far as the outlook is concerned, Mr. Greenleaf, the president, is more than confident that while the great boom of 1898-99 may not be repeated an even line of prosperity may be expected to last for some years, or until a presidential struggle again unsettles us.

CINCINNATI REPORT.

The dearth of activity in machinery-making lines continues. There is, however, a well-marked increase in electrical constructive lines—that is, power machinery for big plants and village and municipal uses. The expected closing of several portfolios of inquiry is still in abeyance with no cessation of inquiry. Conservative machine-tool men believe there will be no discernable improvement until after the first of the year. During the week a big order received from Plattsburg, N. Y., for a new motor company in process of establishment there was placed with four prominent Cincinnati concerns; these are the Cincinnati Milling Machine Company, the Lodge & Shipley Machine Tool Company, the Cincinnati Machine Tool Company, and the Cincinnati Planer Company. A large proportion of the lathes, planers and small tools were purchased here. The four concerns named say that while orders for the month were not quite up to expectations, business was very encouraging and still is of a direct character.

The Devere Electric Company, contractors, have been well occupied the past month putting in some big power plants in interior Ohio cities. Of two among conspicuous ones, one was for the celebrated Bookwalter Hotel, in Springfield. Another was for the Mt. Adams Monastery in Cincinnati. Manufacturers of machinery for electrical power on the whole report business excellent. An order just secured by the General Electric Company is for a 75-kilowatt generator connected to a Buckeye engine sold to the village of Tippecanoe City, Ohio.

In the line of boilers, business is reported by the manufacturers about on a par with the demand for electrical power machinery. The Tudor Boiler Company has just filled a third order to a prominent Ohio coal company, a 500 horse-power water-tube boiler, making a total of 1,250 horse-power sold for this purpose to the coal company. The Tudor company reports an unusual demand for tubular boilers coming principally from the South and through the dealers. Most of these are purchased for engine builders. The company is putting in a large amount of new machinery, principally large tools. The Cincinnati office of the Stirling (Boiler) Company has just captured one of the biggest contracts in this part of the country, an order for 1,000 horse-power of Stirling water-tube boilers to be installed in the works of the National Cash Register Company, at Dayton.

E. A. Schumacher, of Schumacher & Boye, has recently returned from a European trip during which he secured some gratifying business. He agrees with the consensus of opinion among returned travelers this year that while the German market has fallen off the English prospects are relatively good. Henry Dreses, of Dreses, Mueller & Co., has also recently arrived from the other side with similar views.

CHICAGO MACHINERY MARKET.

There is much uniformity in the reports of trade at Chicago and vicinity among the machinists' supply men. It is a continuance of previous activity with some little improvement. This improvement is notable in respect to the Chicago trade proper. Consumption of all kinds of machine-shop supplies is increasing. One large seller remarks that practically all the buildings in the city and suburbs available for manufacturing purposes are now occupied, whereas quite a number were vacant a year ago and still more two years ago. In the numerous shop constructions during the past year, quite a number of manufactories have changed location for the better, usually removing from the congested center of population to the suburbs. The deserted plants have been leased to smaller producers of various kinds and are now running again. One large manufacturing concern, the Bradley Manufacturing Company, which recently moved out of its downtown plants, is said to have had twelve vacant buildings suitable for manufacturing a year ago, and now only one of them, and that the smallest, is unoccupied.

The only cloud on the face of the city's industries is the attitude of organized labor, some recent assaults upon non-union men in the building trades producing a disquieting effect upon those who contemplate the erection of buildings this coming season. If the temper that is now shown among business men in general is any indication, there will be this coming spring quite a change in the industrial aspect of the city. There are many projects involving the construction and operation of large plants here now held in abeyance. Testimony is abundant that many of these designs are yet alive and it is partially from this source that the future looks bright for the supply people. If there is one new feature to this branch of business during the past month, it is that inquiries have increased rapidly. Much new work is contemplated for next spring.

The Charles Munson Belting Company reports a good outlook for belting, many inquirers for next season's needs asking for a considerably larger amount than a year ago. The current volume of trade is much the same as for several months past. Armstrong Bros. Tool Company has recently doubled its floor space and added considerably to its output. An entirely new plant is in contemplation. C. H. Besly & Co. say demand for all kinds of tools and supplies has been excellent during November, their specialties making exceptionally good returns. The trade of the Reeves Pulley Company is expanding steadily, and prospects for the immediate future are for still better trade.

Quotations.

NEW YORK, Monday, Dec. 3, 1900.

Iron—American Pig, tidewater delivery:—

Pennsylvania Irons:

No. 1 X foundry	$17 00	@$17 50
No. 2 X foundry	16 00	@ 16 50
No. 2 plain	15 00	@ 15 50
Gray forge	14 50	@ 15 00

Alabama Irons:

No. 1 foundry, or soft	15 25	@ 16 25
No. 2 foundry, or soft	14 75	@ 15 25
No. 3 foundry	14 00	@ 14 50
Foundry forge, or No. 4	13 50	@ 14 00

Bar Iron—Base sizes—For good refined brands on dock, 1.50 @ 1.60c. upward, and for same from store, 1.75 @ 1.90c.

Tool Steel—Base sizes—Good standard quality, 7 @ 8c.; extra grades, 10 @ 14c.; special grades, 16c. and upward.

Machinery Steel — Base sizes — From store, 1.70 @ 1.75c.

Cold Rolled Steel Shafting—Base sizes—From store, 2½c.

Copper—Lake Superior, ingot in carloads, 17c.; electrolytic, 16⅝ @ 16¾c.; casting, 16⅝c.

Pig Tin—27¾ @ 28c., for 5 and 10-ton lots, f. o. b.

Lead—For wholesale lots, 4⅜c., with .02½ @ .05c. extra for carloads.

Spelter—Prime Western, 4.30@4.32½c., New York delivery.

Antimony—Cookson's, 10½ @ 10¾c., according to quantity; Hallett's, 9¼c.; United States, 9.10 @ 9.35c.; Japanese, about 9c.

Lard Oil—Prime City, 65c. in 1 to 5 barrels and 1 or 2c. less on large quantities.

It is encouraging to note that such lines of finished iron and steel as bar iron, machinery steel and shafting are in unusually good demand for this time of year. Prices are strong with some increases probable by or soon after the first of the year.

Some Tricks in Spacing Gear Teeth —Spacing for Prime Numbers of Teeth by a Jack-in-the-Box Mechanism.

BY A. L. DE LEEUW.

The spacing of a gear, or anything else, for that matter, is generally done by one of three essentially different methods. In the first method the gear cutter is provided with an index plate, having as many notches as there are teeth in the gear to be cut. Each new gear, therefore, requires a new index plate. In the second method, which is followed when the spacing is done on the universal milling machine, a disk is used, with several rows of holes. The number of teeth to be cut, however, is not necessarily the same as the number of holes in one of the rows. This method is too well known to all mechanics to enlarge upon it. In the third method, which is more generally employed in gear cutters, a large and accurate worm-wheel is used, which is turned the required part of a revolution by means of change gears and a worm. This is sometimes done by the machine itself, and sometimes by hand. For instance, if the worm-wheel has 240 teeth, then each turn of the worm corresponds to $\frac{1}{240}$ of a revolution of the wheel. Now, suppose we put a change gear with 73 teeth on the worm-shaft, and on a second shaft (and meshing with the first gear) we put a second change gear, with, say, 40 teeth; then each revolution of the second change gear corresponds to $\frac{40}{73}$ of a revolution of the first change gear, and therefore with $\frac{40}{73} \times \frac{1}{240}$ revolution of the worm-wheel; that is, $\frac{1}{6 \times 73}$ revolution. Six complete turns, therefore, of the second change gear will turn the worm-wheel $\frac{1}{73}$ of a revolution. If, therefore, we want to cut a gear with 73 teeth, we arrange the change gears as stated above, provide the second change gear-shaft with some means for turning it (say a crank, if the spacing is done by hand) and a stop to make sure that we turn the full number of revolutions.

The manner in which the change gear shafts are arranged depends on a number of considerations. The shafts may be fixed in position, in which case a quadrant may be used, holding an idler, to connect the two change gears, or the second change gear shaft may have its bearing in a bracket or stand, which slides toward the first change gear.

Fig. 1 shows an arrangement which is sometimes used to enable the operator to recut a gear. It sometimes is found (especially with heavy steel gears) that the tooth space is narrower than the cutter, in which case it is necessary to take another light cut on one side of the teeth. In order to do so, one might shift the gear slightly on its mandrel, which, of course, is a very delicate operation. Instead of doing so, the arrangement of Fig. 1 may be used. *A* is what we call the second change gear, *B* is its shaft, and *C* a disk keyed to the shaft. This disk is provided with a circular T-slot, which permits the operator to clamp the disk *D* to *C*. This disk *D*, if not clamped, turns freely on the shaft *B;* to *D* is attached the handle *E;* a fixed stop *F* is further provided, which enables one to make a full turn with the handle *E*, or, if required, a number of full turns.

Now, if a gear has to be recut, all one has to do is to unclamp the disk *D* (while *E* is being held in its position by the stop), and shift the disk *C* until the gear to be cut has turned the required amount, when once more the disks are clamped together, and the spacing proceeds as usual.

The worm-wheel method of dividing gears requires a large number of change gears, though not quite a new one for each new number of teeth to be cut. It may be possible, for instance, to cut a gear having 74 teeth with the same change gears as one having 37 teeth, or one having 111 teeth. If the spacing for 37 teeth requires six full turns of the crank, then a gear with 74 teeth requires three full turns, and one with 111 teeth requires two full turns. But if a prime number has to be cut, a new change gear is absolutely necessary, which must have the same number of teeth as the gear to be cut. Unless the artifice described below be used, this is also true if the number of teeth to be cut is a number which can be factored

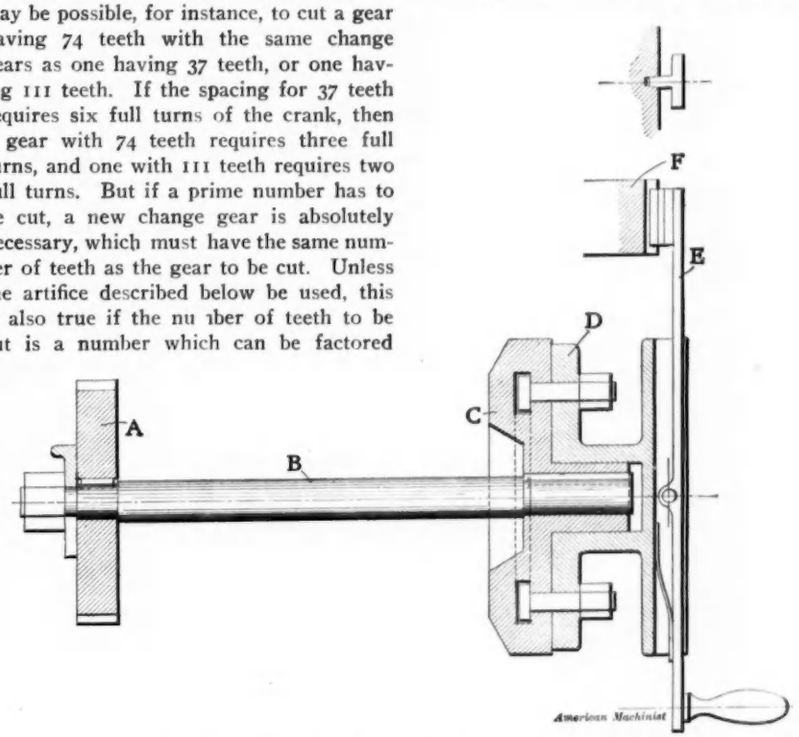


FIG. 1. INDEXING ARRANGEMENT FOR RE-CUTTING GEARS.

(for instance, $119 = 7 \times 17$), but neither of the factors happens to be a divisor of the number of teeth of the dividing worm-wheel, or of the number of turns one has to make with the crank, in order to space for the other factor. To make this clearer with an example, let us suppose we must cut a gear with 119 teeth; further, that the worm-wheel has 240 teeth, and that we have already the necessary change gears to space for 17 teeth. Let us further suppose that it requires six full turns of the crank to space for 17 teeth. The number 119 contains the factors 7 and 17, but neither of these factors happens to be a divisor of either 240 or 6, and for that reason it requires a change gear with 119 teeth to cut another gear with 119 teeth.

Most gear cutters, though not all, are furnished with all the necessary change gears to cut any number of teeth up to 100. Now it quite frequently happens that the machine designer wants a gear with a prime number of teeth greater than 100; this happens, for instance, if one wants to adapt an American lathe to cutting metric pitches; in that case a gear with 127 teeth is required.

Whenever such a thing occurs, there is a great deal of scratching of the head. This, however, does not solve the problem. If the gear to be cut has a number of teeth that can be factored, like 119, the problem is a relatively simple one; but if it be a prime number, the question becomes more difficult; and until now I have not seen a satisfactory solution, except the one I shall offer in this article.

Let us first deal with $119 = 7 \times 17$. Rig the machine up for spacing 17 teeth. Each space will now be equal to 7 teeth. The following tooth gaps, therefore, will be cut: 1, 8, 15, 22, 29, 36, 43, 50, 57, 64, 71, 78, 85, 92, 99, 106, 113. Here we stop, take off the change gears, unclamp the disk *D*, Fig. 1, and put in new change gears for cutting 7 teeth. The disk *D* was unclamped to allow the change gears to mesh properly, without disturbing the position of the worm-wheel. After the two change gears are in place, the disk *D* is clamped once more. If we space now for 7 teeth, each spacing will turn the wheel to be cut $\frac{1}{7}$ of a revolution; so that the next tooth gap cut will be $113 + 17 = 130$. As there are, however, only 119 teeth in the whole wheel, we should call this gap $130 - 119 = 11$. Having cut one gap, we stop again, take off the change gears and put on the old ones, taking care, of course, to unclamp the disk while this is being done. The numbers we cut now will be 18, 25, 32, 39, 46, 53, 60, 67, 74, 81,

88, 95, 102, 109, 116, 4. Stop again, change the gears; then cut gap 21. Stop again, and change the gears; then cut gaps 28, 35, 42, 49, 56, 63, 70, 77, 84, 91, 98, 105, 112, 119, 7, 14. Stop and change gears; cut gap 31. Stop and change gears; cut gaps 38, 45, 52, 59, 66, 73, 80, 87, 94, 101, 108, 115, 3, 10, 17, 24. Stop, and change gears; cut gap 41. Stop, and change gears; cut gaps 48, 55, 62, 69, 76, 83, 90, 97, 104, 111, 118, 6, 13,

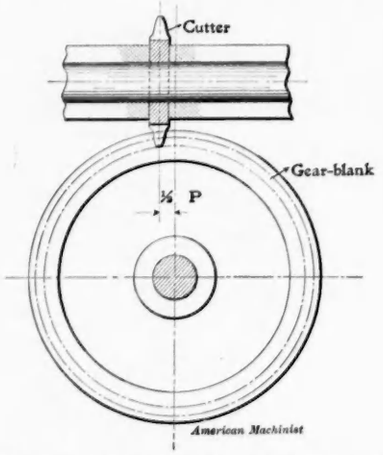


FIG. 2. MAKESHIFT METHOD OF CUTTING GEARS WITH PRIME NUMBERS OF TEETH.

20, 27, 34. Stop, and change gears; cut gap 51. Stop, and change gears; cut gaps 58, 65, 72, 79, 86, 93, 100, 107, 114, 2, 9, 16, 23, 30, 37, 44. Stop, and change gears; cut gap 61. Stop, and change gears; cut gaps 68, 75, 82, 89, 96, 103, 110, 117, 5, 12, 19, 26, 33, 40, 47, 54. This finishes the operation. In sorting out the numbers, one will find them all from 1 to 119.

If the number of teeth had been 143, we would have used the change gears for 11 and 13 teeth, as $143 = 11 \times 13$.

This method seems long, but is really only very little longer than if we had the proper change gears. The lengthiness is all in the description.

If the number of teeth to be cut is prime, or the square (or any other power) of a prime number—for instance, 127 (prime) or 121 (square of 11), or 125 (cube of 5)—the problem is an entirely different one, and not so easy to solve.

I have seen a method of doing it, which is at the best a poor one, both as to operation and results. The gear to be cut is held on the dividing head of a universal milling machine (which, of course, only goes for small gears), and the machine is rigged up for cutting one tooth less than the desired number. Suppose the desired number is 113, then the machine is set for 112 teeth. The gear blank, however, is set off the center to the amount of half the pitch (see Fig. 2). After a tooth is cut, the cross slide is pulled over a certain amount, so as to bring the cutter nearer to the center line of the gear blank, and this amount is calculated to bring the cutter on the center when half the number of teeth is cut. After that the cutter goes further and further away from the center. It will easily be seen that in this way one or two or any other number of teeth may be gained or lost; but it will also be seen that the teeth are all off the center; that they do not even stand in the same direction; that the spacing is a matter of guessing and compromising.

The method I would suggest requires the special rig, of which Fig. 3 is a diagrammatic sketch.

A is the second change gear shaft (the shaft usually turned by the operator); *B* is the handle. In the sketch the disk and stop of Fig. 1 are not shown.

The shaft *C* has the gear *D* which meshes with gear *E*. This gear is keyed to the spool bevel *F*. This bevel meshes with the bevels *G G*, which turn on the trunnions of the piece *H*; this piece *H* being keyed to the shaft *A*. The bevels *G G* mesh with spool bevel *I*. The four bevels together form what is known as a "Jack in the box." If the gear *I* is held locked, and the gear *F* is turned, then the gears *G G* will drive the shaft *A*. This motion of shaft *A*, however, is only half the motion of gear *F*; *i. e.*, if gear *F* makes two revolutions, then shaft *A* makes only one. Anyone can easily see this, if he considers the gears *G G* as levers having their fulcrums where they mesh with *I*. These fulcrums are really the instantaneous centers of rotation of the gears *G G*. Of course, the centers of these gears move only half as much as the driven ends (that is, where they mesh with *F*).

Now if *F* is held stationary and *I* is turned, the same result will follow; and if both *F* and *I* are turned, the shaft *A* will turn half the sum of the motions of the two gears. The application of the "Jack in the box" for adding rotary movements is not new, and I have described it here only for the benefit of those who have not met with the device. The gear *J* is keyed to shaft *A*, and, through gears *K*, *L* and *M*, drives spool bevel *I*.

At the first glance, it looks as if this device must lock itself, but it does not. It seems as if *E* drives *A* by means of the "Jack in the box"; that *A* drives *J* and finally *I*, which in its turn drives *A* by means of the "Jack in the box"; then *A* again drives *J* again, and so on *ad infinitum*. It looks like the nearest approach to lifting oneself by the boot straps, and I am almost afraid that some enterprising inventor may use this device as foundation for a real perpetual motion. But, like many other things, it is not so bad as it looks.

To understand the nature of the result-

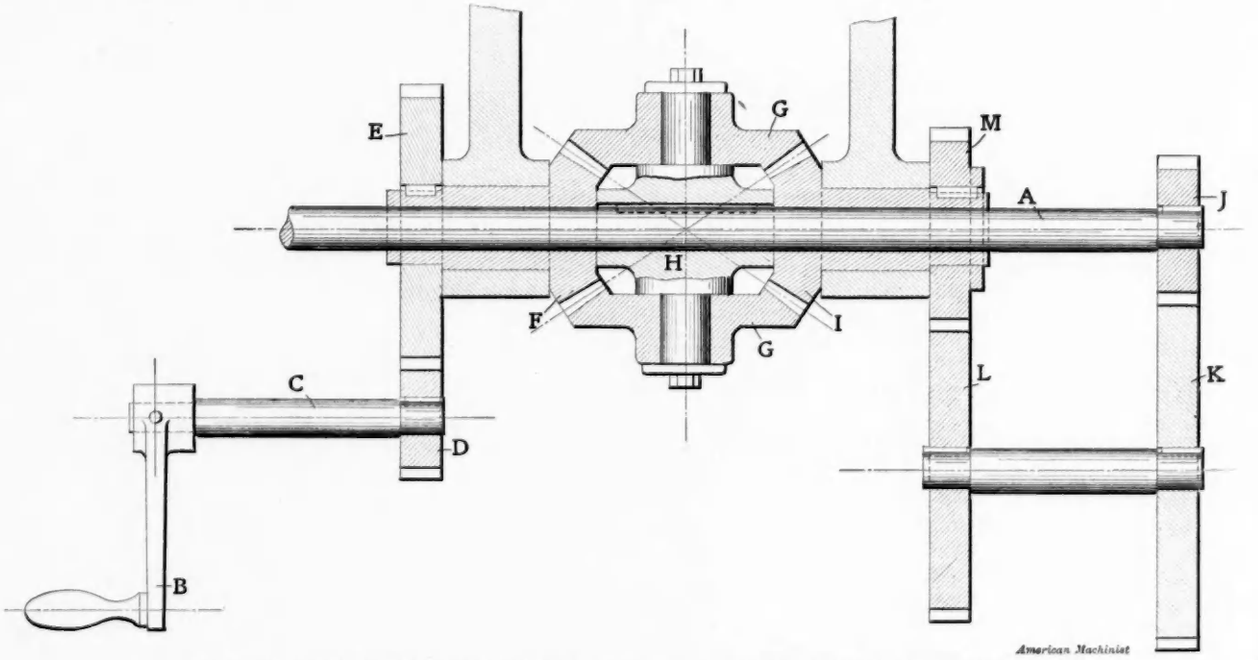


FIG. 3. ATTACHMENT TO GEAR CUTTER FOR CUTTING GEARS WITH PRIME NUMBERS OF TEETH.

ing motion, when the crank B is turned a certain amount, let us assume that the resultant motion is one revolution of the shaft A. Let us further assume that the gearing between J and M causes the latter to run ten times slower than the former. We then have, that shaft A turns one turn, and gear I turns one-tenth of a turn. To better see what effect this has on gear E, we say that shaft A makes one-tenth of a turn and also nine-tenths of a turn. Observe that shaft A and gear I run in the same direction. Observe further that though A and I make their movements at the same time, the result would be the same if I and A first were to turn one-tenth of a turn together and then A should make the remaining nine-tenths of its turn. When A and I turn together (and the same amount) the entire "Jack in the box" must turn this amount, as if it were one solid body. Gear E, therefore, turns in the first place one-tenth of a turn. There now remains to be seen what effect the remaining nine-tenth turn of the shaft A has on gear E. Shaft A carries with it the piece H and gears G G, which in turn rotate gear F; and as we found that gear F travels two turns to A's one (if F is the driver), we now find that gear F must travel eighteen-tenth turns when driven by shaft A (A making nine-tenths of a turn). As gear E made already one-tenth of a turn, its total movement is nineteen-tenth turns.

If we turn crank B so many times that E makes two complete turns, then A must make $\frac{20}{19} = \frac{10}{19} \times 2$ turns.

Now, if A is the shaft, which in the gear cutter drives the second change gear, and the machine is arranged to cut 20 teeth with one turn of that shaft for each space, then this same machine, set up in the same way, but with the above described rig added, will cut 19 teeth (provided we give gear E two full turns where otherwise we would have given one full turn to the change gear shaft).

If we had arranged the gear cutter for cutting 128 teeth, and we had made the gear ratio between J and M 64 (one-half of 128), the machine would cut a gear with 127 teeth. In general, if the gear cutter is arranged to cut $2a$ teeth, and the gear ratio between J and M is a, then the machine will actually cut $2a-1$ teeth, and gear E will have to make twice as many turns when spacing as the second change gear on the machine would make when cutting $2a$ teeth and spacing in the ordinary way.

As I said before, Fig. 3 is only a diagrammatic sketch, drawn without regard for sizes or proportions. More than that, the drawing does not even show the arrangement as it actually should be made. This was done to confine the attention of the reader to the principle of the thing, without troubling him with too much detail. Instead of the spur gears J, K, L and M, we would make even spur gears L and M; but K would not drive M by a simple shaft, but by means of worm and worm-wheel, and, if necessary, with the addition of a pair of miter gears to come back in the proper direction. Instead of the keyed-up gears J and K, we would use change gears. This arrangement would be necessary, if we wanted to make this rig universal; that is, if one wanted to adapt it to cutting any number of teeth. We might, for instance, make the worm-wheel with 72 teeth (or any other number, according to taste and circumstances). If, then, we wanted to cut a gear with 127 teeth, we would have to make the gear ratio between J and M 64, and therefore the change gears, which take the place of J and K, would have to be 72 teeth and 64 teeth respectively, or other numbers in the same ratio.

As every patentee says in every patent, "I do not confine myself to the arrangement as described here," but simply give this as the skeleton around which a practical arrangement may be built—an arrangement adapted to the gear cutter at hand.

For aught I know, this arrangement is new; but I would not be a bit surprised to learn, in the next issue of the "American Machinist," that the Egyptians had used this contrivance when building the pyramid of Cheops; that the Chinese—but never mind the Chinese just now; and that several petrified models of this arrangement had been dug up in Pompeii. However, the thing was new to me, and it is just possible that it is new to one or two other people.

It may be of interest to people who like the study of planetary motions, to find the relation between the motions of gear E and shaft A, starting with gear E. Of course the motion does not change wherever I start with my explanation; but the explanation itself changes very much with the starting point. I myself happened to stumble on to it from the E side, and I will give here the course of reasoning just as I followed it at first:

Disregarding at first the movement of I, if we suppose E to make two turns A will make one turn. This movement of A, however, turns I, which adds to the movement of A, this additional movement of A adding again to the movement of I, which addition to the movement of I adds again to the movement of A, and so on indefinitely. Each additional movement is smaller than the preceding one, and the final movement of A is thus the sum of an infinite converging series. Suppose the ratio between the gears J and M is $\frac{a}{2}$. Then the initial one turn of A will cause M, and therefore I, to make $\frac{2}{a}$ turn. The first additional movement of A will be one-half of this, or $\frac{1}{a}$, and the total movement of A up to this point is $1 + \frac{1}{a}$. As before, this additional $\frac{1}{a}$ turn of A gives another addition to the movement of I of $\frac{1}{a} \times \frac{2}{a} = \frac{2}{a^2}$, which results in a second addition to the movement of A of one-half as much, or $\frac{1}{a^2}$, giving a total movement to A up to this point of $1 + \frac{1}{a} + \frac{1}{a^2}$. The same law continues indefinitely, the series or progression which gives the total movement of A being $1 + \frac{1}{a} + \frac{1}{a^2} + \frac{1}{a^3} + \frac{1}{a^4} + \ldots\ldots$, and by the well-known rules, the sum of this series is $\frac{a}{a-1}$.

Hamilton, Ohio.

Port Openings in Single Valve Automatic Cut-off Engines.

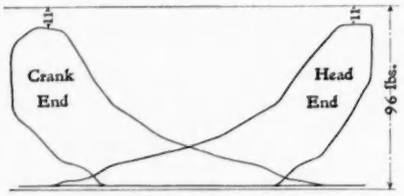
It is well-known to all who have to do with shifting eccentric single-valve automatic engines that the port openings provided at the usual points of cut-off do not even approach those called for by the rules given in the text books; though we are not aware that anyone has, until now, measured the actual port openings and then compared them with the indicator cards made by the engine. Notwithstanding the small openings, the fall in pressure between steam chest and cylinder is not as great as would be expected, and the subject is worthy of investigation.

Some years ago Professor Sweet called attention to the action of his throttle valve when partly closed. In this valve a disk with a hole through it turns over a seat having a corresponding hole. The opening is "straight way," and the position of the valve gages accurately the capacity of the opening—a valve, when in the middle position, having exactly half the opening that it has when full open, and the professor found, if we remember rightly, that the valve must be about half closed before any appreciable effect was produced on the indicator card. Such considerations have led those who have had opportunities for observation to conclude that a steam passage may be constricted within wide limits by sharp edges without much effect on the flow of steam.

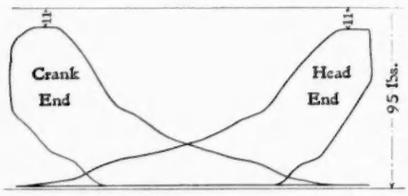
Mr. Begtrup has called attention to this matter anew in his article on "Steam Ports, Port Openings, etc.," and, reflecting on the unsatisfactory condition of our knowledge of the subject, we have persuaded a friend who has every facility for making experiments, but who prefers to remain unknown in the matter, to make the necessary observations. The results are presented herewith. The method employed was to load an engine with a friction brake, so that the load could be varied, and then to take indicator cards at various loads. The valve rod had a sharp point attached, which was made to scribe a line on a strip of tin pressed against it at the instant of taking the card. In this way a record of the exact valve travel at the in-

stant was obtained, and by working backwards through the known dimensions of the valve and ports, the exact openings which gave the various cards can be determined. As it was impracticable to insert the steam gage in the steam chest, it was placed in the steam pipe 20 feet from the engine. The gage had been recently tested. No doubt the pressure in the chest was somewhat below that shown by the gage, and this loss due to the 20 feet of pipe is, in the diagrams, added to the loss due to the ports. The cards are, however, fairly comparative, and they show clearly how little effect is produced by the reduced openings at the earlier cut-offs.

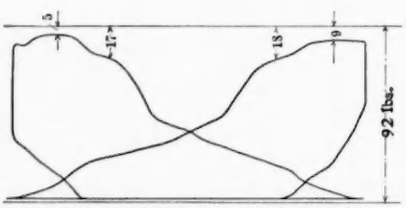
The engine is a 10x10, the speed being,



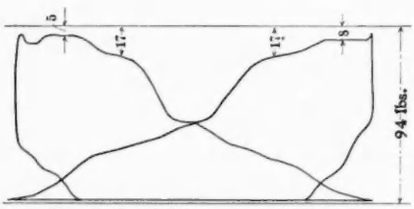
Card 1. Speed 301 r. p. m. valve travel 1.745 inches.



Card 2. Speed 301 r. p. m. valve travel 1.755 inches.

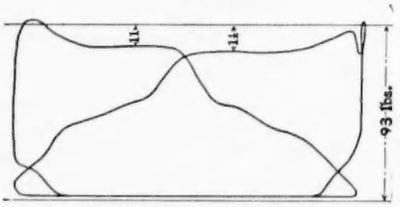


Card 3. Speed 300 r. p. m. valve travel 1.86 inches.



Card 4. Speed 301 r. p. m. valve travel 1.98 inches.

American Machinist



Card 5. Speed 303 r. p. m. valve travel 2.37 inches.

EFFECT ON INDICATOR DIAGRAM DUE TO VARYING THE PORT OPENING.

approximately, 300 revolutions per minute. The actual speed, the steam pressure and the valve travel are shown on each of the cards, which are reproduced herewith. The engine is double ported, each port being 6⅞ inches by 11-16 inch, the lap at each end being .742 inch.

The old rule for steam ports is, to make them of such size that the velocity of the steam through them shall be not more than 6,000 feet per minute, which, at 600 feet piston speed per minute, calls for a port of one-tenth the piston area. The piston speed in this case, with sufficient accuracy for the purpose, was 500 feet per minute, which would call for a port equal to $.1 \times \frac{5}{6}$, or 8.35 per cent. of the piston area, or 6.55 square inches. The actual area is $6\frac{7}{8} \times \frac{11}{16} \times 2 = 9.45$ square inches, which is 12 per cent. of the piston area—an excess of area above the rule of 43.7 per cent., so that there can be no doubt that the port area is sufficient. By the same rule the port should open to steam three-fourths of its width, giving an area of opening of 6.25 per cent. of the piston area, or 4.91 square inches.

Subtracting twice the lap from the travel for each card, and dividing by 2 gives the width of the port opening, and multiplying this by the length of the port gives the area, which may be directly compared with the piston area and with the area called for by the rule. The cards are numbered in order, beginning with the shortest cut-off, and the accompanying table gives the opening figured as a percentage of the piston area in the manner above described, and a comparison of this area with the area called for by the rule:

Number of card.	Area of port opening as a percentage of piston area.	Area of opening divided by area called for by the old rule.
1	2.27	.363
2	2.36	.377
3	3.38	.524
4	4.32	.69
5	7.76	1.24

That is, in cards 1 and 2 the actual area is but little more than one-third of that called for by the rule, while in 3, which represents about an average point of cut-off with economical load, it is but a little over one-half. Comparing the performances, the drop in the steam line of cards 1 and 2 is greater than in cards 3 and 4, measured at the most favorable point of the latter, but less when measured at less favorable points, while it is slightly less than in Fig. 5, although the opening for the latter card has 3.41 times the area of that for the former.

The influence of the steam pipe between the pressure gage and the steam chest vitiates the comparison to a certain extent, as, while its size remains fixed, more steam must be drawn through it with late cut-offs than with early ones, but the inference is unmistakable that a very decided constriction in the steam passage has a very slight effect on the flow of steam.

It is common to explain the action of the small parts by reference to the fact that they go with early cut-offs. The velocity of the piston being less at the early cut-offs, the velocity of the steam through the ports is correspondingly less, and hence it is argued that it should be expected that smaller ports should answer. We are convinced that the importance of this action is much exaggerated. While the velocity of the piston is greatest at the quarter and least at the center, the acceleration is just the reverse. The resistance offered by the steam to its flow through the ports must be partly due to the factor of its own acceleration, the total resistance at any position of the piston being the sum of that due to friction and that due to acceleration, one of which factors increases while the other decreases. Unless there were some such compensating action the effect of the increased velocity at the quarter would appear in the exhaust line. The steam is forced through the exhaust port at various velocities at different positions of the piston, and if its friction in the passage were the only factor, the exhaust line would arch upward; but, in point of fact, it is almost invariably straight. In the case of the exhaust, too, the varying width of the port opening at different positions of the piston is not present to complicate the question. Owing to the smallness or absence of inside lap, the port is opened to exhaust to its full width for a large portion of the stroke. It may be fully opened even before the return stroke has begun, and remain so until the piston has advanced well past mid-stroke, so that the entire first half of the stroke is made under constant conditions as regards the size of the port opening. The velocity of the piston and of the steam through the port steadily increases as mid-stroke is approached, and yet the exhaust line does not rise.

The subject of the small port opening is by no means exhausted by this article. It is highly desirable that simultaneous cards be taken from both cylinder and steam chest, together with records of the valve travel, such as are described above. As the difference of the pressures shown by the two cards is the important feature, the indicator springs should be compared to see that they have the same scale, or, if different, to find the proper allowance to make. It would also be advantageous to know the exact point of cut-off, as this cannot be obtained with any degree of certainty from the cards. If any of our readers feel like making such observations, which really involve very little labor where the facilities already exist, we shall be glad to make the comparison of the cards, as we have done in this case.

The Engineer in China.

"Engineering" for October 5 contains an article under this title which is the best exposure of the hollowness of many of the claims for "liberal education" we have ever seen. No apology is needed for publishing the following liberal extracts from it:

All the European newspapers are proclaiming that China must be civilized, quite regardless of the fact that there was a highly-developed civilization in China at the time when the inhabitants of these isles were painted savages, and that the intervening centuries have seen no decline in the Celestial Land.

. . . . . .

There are, of course, degrees in civilization, and no nation has yet attained to finality in this matter. We are painfully aware of our defects, and of how much remains to be done before even the worst blots are cleaned off our social system. But, curiously enough, the remedies which are proposed here are quite different from those we are so ready to prescribe for China. Here the platform and the press ring with the praises of elementary education, secondary education, sanitation, temperance, improved dwellings, workmen's clubs, cookery classes, and the like. Every philanthropist has his own pet plan for making people less like the apes and more like the angels. But when the improvement of China is under discussion we hear nothing of these panaceas. Omitting the programs of the missionary societies, which are far too contentious ground for us to venture on in these columns, the remedy which is universally put forward for the ills of that country is engineering. Its salvation is to be found in the roads, harbors, railways, electric trains, sawmills, factories, and a thousand of the other products of the engineer's art and science.

. . . . . .

The regeneration of one-fourth of the human race is confided to the engineer, apparently with the full assurance that he is quite capable of effecting it in a short time, if he be not prevented by the obstinacy of those whom he is to benefit so greatly.

All this is exceedingly flattering to our profession; partly because there is a substantial groundwork of truth in it, but more particularly because it is so very far removed from the opinion of our work which is generally expressed.

. . . . . .

It would be quite possible to pursue the subject in many directions, but it is hardly necessary in these columns to labor the point that the inventor, the mechanic, and the engineer, lay the foundations of all social progress, and that without them society, particularly in the lower strata, must remain very imperfect. Nevertheless, it is a wonderful thing to find this truth fully realized by the public, although at present it seems as if the application of it were confined to China.

There are many points of resemblance between social customs in China and in England at the present day, while if we carry our thoughts back fifty years, the resemblance becomes even more striking, with the exception that purely intellectual attainments have always been more highly regarded in the Celestial Land than here. In China the two qualifications which give social precedence are birth and educational attainments. The examination system was in full force there hundreds of years ago, and upon a man's success under it depends to-day very greatly his position in life. The studies are strictly classical; the Oxford Don, who boasted that there was nothing useful taught at his university, would have been quite in his element in China. The writings of Confucius and of the poets furnish a great part of the mental pabulum of the students, but so keen is the competition that it needs great mental powers to pass the higher examinations. Probably, as a means of training the intellect, and stimulating it to the highest activity, the Chinese system of education is equal to any in the world. It certainly bears a great resemblance to that which obtains in this country. Here the mental training held in the highest esteem is that which consists in the study of literature, and particularly in the literatures of Greece and Rome. Much of this is of about the same date as the classics of China, and is not much more in harmony with the sentiments and needs of the nineteenth century than they are. We might go further and say that it produces much the same effect on many minds; in other words, it introduces a false and conventional standard of education. The fine old English gentleman of fifty years ago, who came of a county family and had received a university training, regarded the engineer very much as the mandarin regards the Englishman to-day. He admitted that he was clever in his craft; that he could bend the forces of Nature to his will, and that he could accomplish by his art things which formerly had been held to be possible only by magic. But, not for one moment would he acknowledge him as an equal. If the engineer had asked his daughter in marriage he would not only have refused him, but would have done so with contumely. He acknowledged only one kind of intellectual eminence, and that was the one stamped with a university degree.

The Chinese mandarin stands on much the same mental platform. The "complete gentleman," in his opinion, can be made only by one system, and all who do not follow that system are not gentlemen. It is not that he entirely despises the arts and inventions of the Westerns, but he would rather forego the conveniences attaching to them than endure the society of their authors. He recognizes the masterful and aggressive character of the European, and feels that the only method of safeguarding himself is to limit, and, if possible, to prevent, all intercourse with foreigners. The idea that such people can civilize *him*, that they can raise him in the social scale and widen the horizon of his mind, is too absurd for a moment's consideration. His contempt for them is even deeper than that of a Vice-Chancellor of an ancient university for a professor of engineering at a north country college.

It is no wonder, therefore, that the sudden and vigorous "civilizing" of China by Western nations, which has gone on since the Chino-Japanese War, has led to an outbreak. We can readily realize somewhat of the feelings of the Chinese, if we imagine a number of Americans of the type set forth by Dickens in his "American Notes"—if such people ever existed—coming over here armed with the powers ascribed by novelists to the inhabitants of Mars, and obliging us to admit overhead railways in Piccadilly, and to turn Westminster Abbey into a machine shop. Whatever might be the material advantages of such proceedings, it is certain that the strangers would have to demonstrate their magical power very impressively before we should consent to their plans, and that we should nurture a deep, undying hatred to them forever. Such being the case, we shall be wise not to expect a too-rapid civilizing of China by the engineer. No doubt he will effect a wonderful change in the long run, and that by machinery he will work all those reforms which in this country are ascribed to other means. But we have only to look back to the history of railways at home to realize the difficulties. No graves of ancestors were likely to be desecrated here. Yet there are many engineers now living who can remember when surveyors ran the risk of personal injury when laying out lines of railway in this country, so intense was the objection of land-owners to have the iron roads on their estates. There are important towns which are off the direct route of main lines, because they offered too violent an opposition to their approach. It is only sixty years ago that such things happened, and at that time Englishmen considered themselves the most civilized nation of the world. It does not follow, therefore, the Chinese are uncivilized because they entertain similar ideas now.

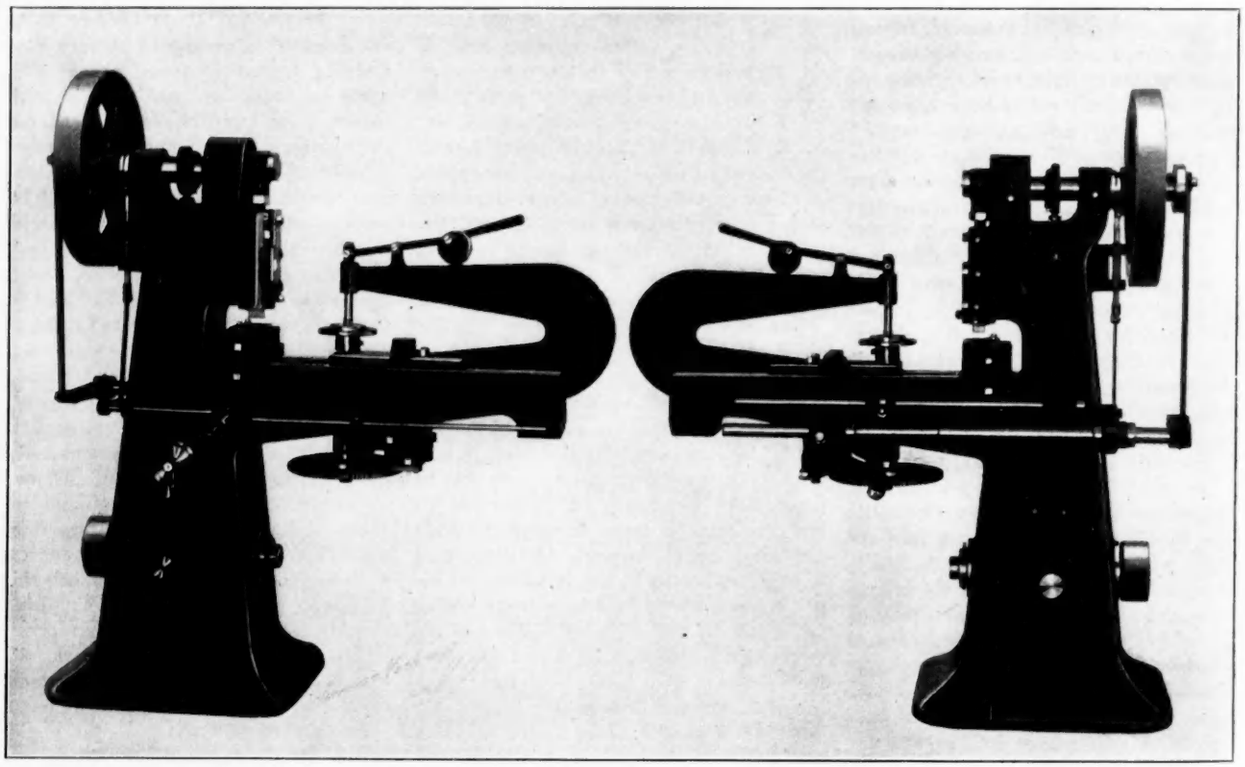
In spite of all opposition the engineer will eventually, by aid of machinery, create a moral revolution in China. The obstinacy of the mandarin and the ignorance of the coolie will be ineffectual to prevent it. Probably the engineer will gain no more credit for it than he has done here, all the fame being reaped by the statesman and the philanthropist. Nevertheless, when the steam tramp has supplanted the junk, piracy will become extinct; when wages have risen in the way they are doing in Japan, owing to the introduction of machinery, infanticide will disappear; when railways have made communciation easy and rapid, likin dues

will become impossible, and one means of extortion by the governors will be removed; when newspapers have become general, the venality of judges will cease, either from the pressure of public opinion, or by means of a revolution. The engineer is the friend of the poor man all over the world, giving him cheaper food and better clothing, and rendering him more able to resist oppression and wrong. No wonder he finds small favor with the classes who desire things to remain as they are, either in England or China.

An Electrically Driven Automatic Armature Disk Notching Machine.

The half-tones show both sides of an interesting machine which in these days should find extensive and constant employment. It is for notching or slitting the edges of armature disks, which it does by punching, the machine being therefore a specially designed vertical punch. In connection with the half-tones, Fig. 1, the working drawing of the machine, Fig. 2, will enable it to be easily understood. The punch proper is of a not unfamiliar type. The vertical movement of the punch is taken from an eccentric pin on the front end of the shaft by a short, heavy connecting rod whose length may be adjusted, thus locating the limits of the stroke of the punch, by the right-and-left screw *E*, which is its central and principal member. The motor by which the punch is driven is entirely enclosed in the base of the machine, only the end of its shaft projecting at the back, with a small pulley, which is belted to the pulley flywheel on the punch shaft. The handle and disk of the controller are seen on the side of the machine at *F*.

The disk to be punched, not shown in either view, is placed upon the circular plate on the upper end of the vertical spindle *A*, and is held in place by the pressure of a similar plate on the lower end of spindle B. The pressure on this spindle is applied by lever *C* and the hand-operated cam *D*. When the disk is being punched, it and the clamping plates and their spindles turn together by the operation of the indexing mechanism. The index wheel *G*, on the lower end of spindle *A*, has on its periphery a number of V-notches equal to the number of notches to be cut in the disk, or some multiple of that number. After each stroke of the punch, the index wheel is moved along one or more notches, as required, by the pawl *H* operated by shaft I and pin *K* on the end of the shaft above. Pin *K* is secured in a slot on the face of a small crank disk, so that the travel of the pawl *H* may be accurately adjusted. On the return stroke of pawl *H*, when the punching takes place, the disk is locked by the V-pointed pin *L*, which is operated by cam *M*, located on the punch shaft between its bearings. The punching goes on automatically until the disk has been punched all the way around, when a pin on the upper side of the index wheel moves the trigger *O*, which unhooks the toe of hand lever *P*, and the weight of the handle is then sufficient to throw out the clutch and stop the machine. As disks of various diameters are to be punched, the entire disk carrying and indexing arrangement is mounted on a carriage which may be moved backward or forward and secured as desired. The three horizontal shafts by which the various motions are transmitted are all of sufficient length and splined to accommodate the carriage movement. The machine here shown punches disks from 6 to 40 inches in diameter and with any number of notches and of any depth required. It is built by Jas. Clark, Jr., & Co., Louisville, Ky.



ELECTRICALLY DRIVEN AUTOMATIC DISK NOTCHING MACHINE.

Some Reasons for Making Hollow Shafts.

We have been asked the following questions:

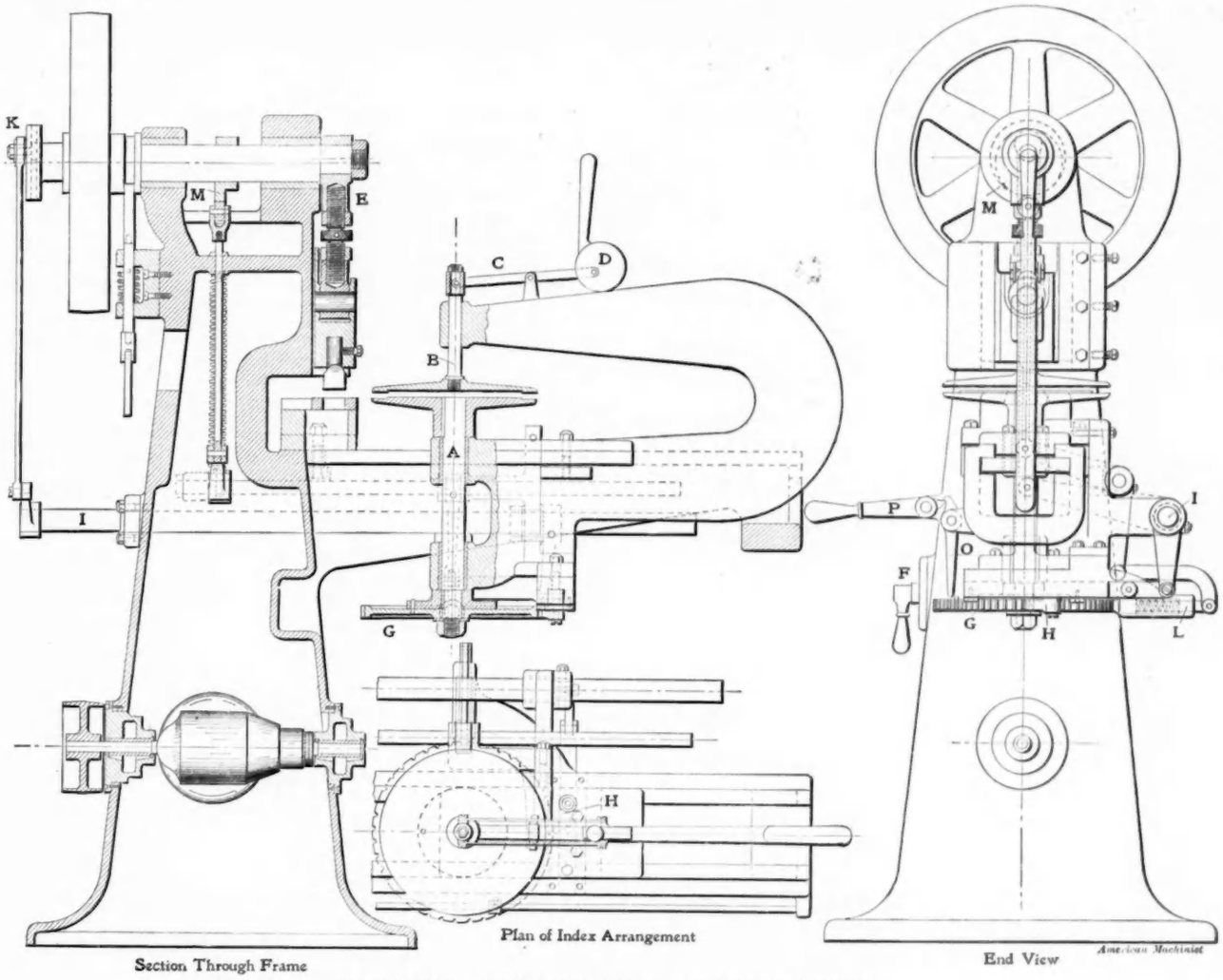
1. What is the object of boring a hole lengthwise through the center of forged shafts?

2. Is there any regular practice that is followed in proportioning the diameter of the hole to the diameter of the shaft?

3. Is the length of the shaft considered in determining the diameter of the hole?

4. Would anything be gained by boring out the center of a rolled shaft or a forged piston rod?

It seems to be the special mission of Mr. H. F. J. Porter, of the Bethlehem Steel Company, to enlighten people on these matters, and we therefore asked him to answer the questions, which he does as follows:



ELECTRICALLY DRIVEN AUTOMATIC DISK NOTCHING MACHINE.

"In order to answer these questions intelligently, succinctly and without waste of time and space, I ought to be able to ask their propounder a few questions, in order to assure myself in advance of what he is after. For it should first be stated that large shafts, which best practice now demands should be hollow, are not bored, but 'hollow forged.' Medium-sized shafts only are 'bored,' while small shafts coming within the limit of rolled material are seldom made hollow. I will, however, answer the questions as you have submitted them to me, and if I do not elucidate the matter clearly to the mind of your inquirer, let him come again, and perhaps I may be more successful the second time.

"I will assume in advance that forged steel is the metal of which the shafts under consideration are made. The shaft has evolved in the passage of the ages from the primitive stick of wood through cast iron and wrought iron to forged steel; but there is no intimation that an animadversion into matters archæological is desired, and I will therefore confine my remarks to the best modern practice.

"1. The reasons for making a shaft hollow may be dual: (1) Those on the part of the purchaser. He may want to simply eliminate weight, as in the case of marine engine shafts, especially for torpedo boats and high-speed yachts, where all unnecessary weight is undesirable; or he may wish to use it in a mechanism of special design, where it serves as a quill, another shaft revolving within it; or he may desire to keep it cool by running water through it; or it may be advisable to inspect the quality of the material of which it is made and insure the absence of internal defects. (2) Those on the part of the manufacturer. All steel ingots from which forgings are made have certain inherent defects, and the larger the ingots the more pronounced these defects become. These defects are principally 'piping' or shrinkage cavities and 'segregation' or a concentration of certain chemical elements which are introduced into the composition of the steel, to affect its physical properties; both of which defects occur along the line of the central axis in the process of cooling from the fluid state. Segregation causes a porous core in this location.

"Many methods have been devised to overcome these defects, but without doubt the most successful has been the Whitworth process of fluid compression, where the casting process is accomplished under hydraulic pressure of several thousand tons. By this means small ingots are cast absolutely solid and homogeneous and in large ingots the above defects are minimized.

"It will be seen that if proper forging appliances are used subsequently, it would be necessary, from the point of view of the manufacturer, to bore out the center of *large* ingots only, as the metal of small ingots would be sound.

"Best practice requires that large forgings be 'hollow forged.' By this term is meant that after the ingot is bored and reheated, a mandril is inserted in the axial hole, and the ingot is then forged to shape under hydraulic pressure, after which the mandril is withdrawn and the axial hole reamed out.

"The manufacture of a shaft in this manner presents the following advantages: First, the defective axial metal is removed before forging, and opportunity is offered to examine the interior for possible defects; and second, the thin wall of metal between the press and the mandril is more thoroughly worked than would be the case if the pressure had to pass through a mass of metal as thick as that of a solid

shaft of the same diameter. The metal is worked also at a lower and more uniform heat, and thus higher physical properties are insured.

"Medium-sized shafts, and sometimes shafts as small as 7 or 8 inches diameter, are bored, in order that they may be oil-tempered to raise the physical properties and establish a fine grain in the metal. The thin walls of such shafts give ample opportunity in the reheating process for uniform expansion, and during the rapid cooling in the oil bath there is a minimum of danger of cracking, as there is no solid core present for the surface metal to shrink upon.

"2. In proportioning the inside and outside diameter of a hollow shaft, these dimensions are carefully worked out to suit the requirements of each individual case.

"By using the formula $d^3 = \frac{(d_1^4 - d_2^4)}{d_1}$

where

d = diameter of solid shaft,

d_1 = outside diameter of hollow shaft,

d_2 = inside diameter of hollow shaft,

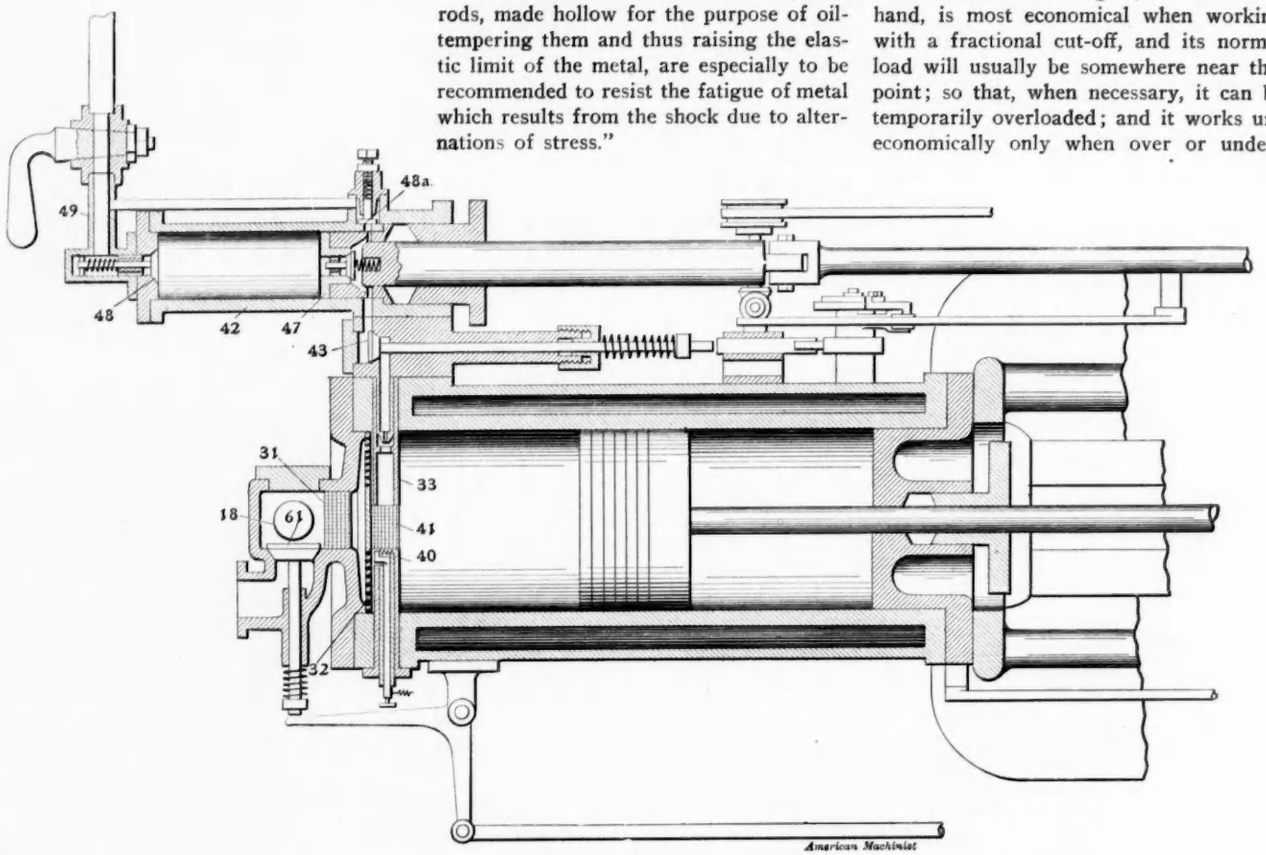
the relative proportions of solid and hollow shafts of the same material can be calculated.

"3. The length of the shaft is of course considered in determining the diameter of the hole, for the shaft must be strong enough not to deflect beyond prescribed limits; but the distance between bearings can usually be modified to meet such requirements.

"4. Rolled shafts are never used for service where material of high physical properties is called for. On general principles it does not pay to spend money on cheap material, and boring rolled shafts usually releases internal strains which spring them out of true.

"Forged piston rods are frequently made hollow. If working horizontally, hollow piston rods are especially advantageous on account of lightness.

"Steam hammer and rock drill piston rods, made hollow for the purpose of oil-tempering them and thus raising the elastic limit of the metal, are especially to be recommended to resist the fatigue of metal which results from the shock due to alternations of stress."



A NEW ATTEMPT AT A "FLEXIBLE" GAS ENGINE.

A New Attempt at a Flexible Gas Engine.

An interesting attempt to solve the problem of producing a gas engine which shall be flexible in its output, in the same way that a steam engine is flexible, is described in a patent recently issued to Franz Burger, of Fort Wayne, Ind., and numbered 657,392. This engine is in a sense a combination of the old Brayton "Ready Motor" and the Diesel "Rational Heat Engine." As it well known, the gas engine of the ordinary explosion type is defective in that it is most efficient when working at full load, with a full charge of mixture in the cylinder, and if this charge be reduced by throttling to produce a lighter impulse under light load, the diminished compression thereby caused results both in slower combustion than is desirable and in materially impaired thermal efficiency. For this reason the hit-and-miss method of governing, by which the supply of mixture is cut off altogether when the speed of the engine rises above the normal, is usually employed where economy is a prime consideration; and governing by throttle is employed only when steadiness of running is of more importance than economy. Again, as an engine is usually called upon for a variable output, it results that the gas engine is usually working at a point below that of maximum efficiency, at which latter its power is naturally rated. The steam engine, on the other hand, is most economical when working with a fractional cut-off, and its normal load will usually be somewhere near this point; so that, when necessary, it can be temporarily overloaded; and it works uneconomically only when over or under-loaded, instead of, like the gas engine, when doing its average work.

In the Brayton engine, and more recently in the Diesel engine, the attempt has been made to overcome this defect of the gas engine by modifications of the internal action which should do away with the explosion principle. In the former, the gas and air were compressed together by a pump, and admitted through a valve into the cylinder in a stream during the first quarter or so of the piston's working stroke. A pilot light in the cylinder, fed through a separate tube from the compressed mixture, ignited the stream as it entered the cylinder, and a suitable screen of wire gauze prevented the flame from striking back into the compression chamber. By this arrangement the working cycle was carried out in two strokes; and, although the point of maximum efficiency —and therefore of normal load—would

evidently be that of a comparatively short cut-off with a liberal after-expansion, yet it is evident that by prolonging or shortening the admission, both an over and an underload could be taken care of. This we understand to have been done by Brayton in his gas engine, and it is evident that the principle of the operation is as near that of a steam engine as could well be conceived.

The great difficulty with Brayton's engine was that the wire gauze screen above mentioned would fail, on the slightest puncture, to prevent the flame from striking back into the preliminary compression chamber. On this account Brayton abandoned the use of gas and adopted kerosene, which he injected into a loose mass of felt, or similar substance, just back of the gauze screen. A small jet of air, independent of the main supply, was directed on this at an angle, so that the kerosene was more or less atomized before being drawn by the main air current into the cylinder. Whether because of the less perfect mixture, or because the kerosene kept the gauze screen cool, this did away with the difficulty of the flame striking back. Instead, however, of retaining the variable cut-off on both oil and air, Brayton varied the quantity of oil injected alone. As, under the circumstances, the oil mingled in varying quantities with practically the whole charge of air, this arrangement was foredoomed to failure from the irregularity of the combustion. In addition, Brayton fed the pilot light from the same uncertain mixture. Consequently the engine would operate in practice only under a constant load, and a promising attempt at a flexible gas engine went down into history as a most dismal failure.

The Diesel engine has been too recently described in these columns to need detailed mention here. It suffices to say that it works on the four-stroke cycle, and instead of an explosive charge being admitted to the cylinder, pure air alone is compressed. This compression is carried to 500 pounds or more, and at the dead point gas or a spray of oil is forced into the highly compressed air, where it ignites and burns spontaneously from the heat generated by the compression. A variable cut-off is applied to the fuel valve, and the brake efficiency of the Diesel engine varies very little from half load to the maximum capacity of the engine. In theory the Diesel engine is the most perfect heat motor ever produced, but it labors under the practical disadvantage of requiring a compression so high that its retention by packing rings and valves is extremely difficult. The loss due to leakage is more serious as the pressures dealt with are higher; and the high compression which makes the efficiency and the flexibility of this motor possible may be considered as at once its making and its bane.

In the Burger engine a return is made to the more moderate pressures of the Brayton engine; but instead of the gas and air being compressed together in one chamber, they are here separately compressed and admitted into the cylinder by independent orifices. The quantity of air admitted is uniform for all loads, the gas alone being regulated by a variable cut-off; but as the gas burns as fast as it enters, the difficulty of varying proportions in the mixture is avoided. The illustration, re-drawn from the patent drawings, shows clearly how this system has been worked out. To economize working parts, the air is compressed in the front end of the cylinder, by valves not shown, and it passes thence into a receiver in the base. An exhaust valve 61 is open during the last stroke of the piston in the usual manner, and as the piston starts on its out stroke the inlet valve 18 admits the compressed air from the receiver. This valve is held open during the first portion of the stroke, or until substantially as much air has entered the cylinder as is compressed in the other end each stroke. Meanwhile the gas, supplied by the pipe 49 and valve 48, has been compressed by the plunger 47 into the right-hand end of the cylinder 42. A valve 43 is then opened by suitable mechanism, and the compressed gas enters the cylinder by way of the burner 33, under a pressure slightly higher than that of the air. The clearance space is presumably made as small as possible; and, as the flame and products of combustion are carried by the piston along with it, and fresh air is entering as long as fresh gas is admitted, it would seem that the conditions were the most favorable possible for perfect combustion.

The inventor proposes to employ the principle of the Bunsen burner in burning the gas, and it will be seen that the burner 33 is constructed with this in view. A metal plate 32, with perforations around its outside, is intended to distribute the inflow of air, and a mass of wire gauze or other material 41 is placed in the path of the flame, where it will act as an igniter. A further refinement is the addition of a regenerator 31 of wire gauze or some refractory material, which will absorb heat from the exhaust gases and give it up to the fresh charge of air. To ignite the first charges, when the engine is cold, a platinum wire 40, electrically heated, is employed. A spring-seated by-pass valve 48a permits the excess of gas in the cylinder 42 to return to the supply pipe when the valve 43 is closed early under light load.

We imagine it would be impossible to say beforehand what the actual performance of the engine described would be, especially as regards the Bunsen burner and the perforated plate for distributing the air. These details are obviously subject for experiment, and not impossibly prolonged experiment at that. In fact we have inquired without success for information as to what has actually been accomplished by the inventor. There appears to be no reason, however, why an engine embodying the principles indicated should not be successful. The working pressures proposed in the patent specifications—100 to 150 pounds—appear to be unnecessarily low, and it seems likely that such improvement in economy as may be gained will result rather from the circumstance that the engine will be most efficient under average loads than from any raising of the percentage of efficiency under the most advantageous conditions. At all events, the engine is an interesting contribution to gas-engine science, and as such it will undoubtedly influence subsequent attempts to secure a flexible internal-combustion motor.

Preservation of Historic and Scenic Places.

There has been sent us a copy of the annual report of the Society for the Preservation of Scenic and Historic Places and Objects, to the Legislature of the State of New York. This society is doing good work and there remains plenty of the same kind to keep its hands full indefinitely. No class of men need to study this pamphlet more carefully than those given over to industrial pursuits, for it is an unscrupulous industrialism that makes the report necessary, and they will read here of one class of cases in which it is possible to be too practical. When, some time ago, Poe's cottage at Fordham was used as the "Poe Laundry," with the sign of a raven out in front, it might have been well enough, since this did not necessarily inflict irreparable injury upon the building, and it was not destitute of humor. But the injuries inflicted by the quarrying that has been done on the face of the Palisades are neither reparable nor humorous. It is to be hoped that the efforts of the society for the preservation of that splendid range of cliffs will be successful, even if machinery manufacturers thereby lose the sale of a few rock drills and crushers. Last summer the writer visited the old house at Tappan where André awaited the execution of his death warrant. The house itself was in a similar state at the time, for (according to the plan at that time) it was just about to be converted into a soap factory. We cannot too heartily commend the work that is being done by the society to preserve the Revolutionary fortifications on Lake George and elsewhere, provided the public can revive their associations discriminatingly, as subjects for imitation, not in their sanguinary phases, but in the principles represented.

Molten Wood.

A material for use in the arts is molten wood. Vice-Consul General Hanauer, of Frankfort, tells us about it. By means of dry distillation and high pressure, the escape of developing gases is prevented, thereby reducing the wood to a molten

condition. After cooling off, the mass assumes the character of coal, yet without showing a trace of the organic structure of that mineral. The new body is hard, but can be shaped and polished at will. It is impervious to water and acids and is a perfect electric non-conductor. The process of its production has been developed by M. De Gall, inspector of forests at Lemur, France.

Molding a Casting by Bedding in the Floor.

BY R. H. PALMER.

Fig. 1 shows the side of the casting and Fig. 2 the top of the pattern. The system of bedding patterns in the floor in the foundry, or, as molders term it, "bedding-in," has many advantages in point of economy over the system of molding

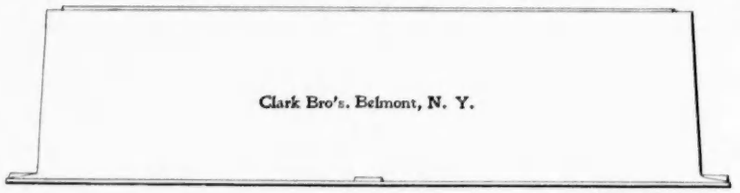


FIG. 1. SIDE OF CASTING.

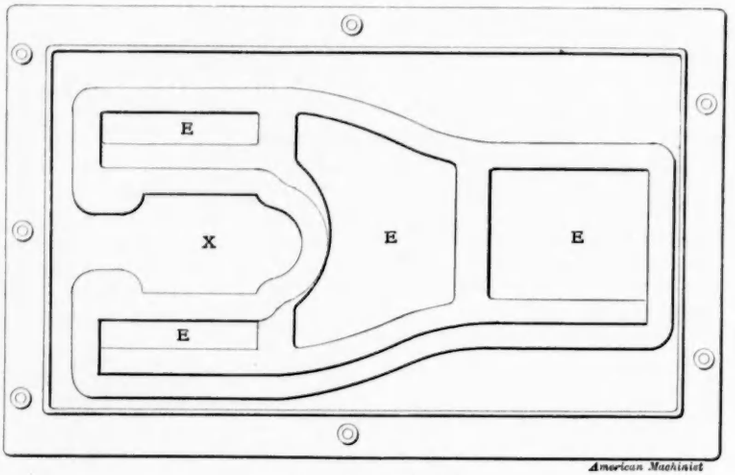


FIG. 2. TOP OF PATTERN.

everything in a flask, and it is a necessity to the jobbing foundry making a great variety of work. The specialty foundry has the advantage usually in having in use certain patterns for which it specially fits up flasks. Yet the amount of space occupied by the flasks of one of the large foundries of to-day is very large, and in many cases the ground rent amounts to considerable. In bedding-in work one cope may answer for many molds, often without alteration, as long as it is large enough to cover the pattern, and leave enough for a joint, while cheeking-off is done by the use of cast-iron plates and lifting out the sides or ends of the mold. Many times this can be done in bedding-in work and the pattern may be molded in less time than in a flask by one accustomed to making castings in this way. To a molder accustomed to a flask for everything, such a statement may seem erroneous, yet one firm who was accustomed to have a certain casting weighing some 6,500 pounds made by bedding the lower half of the pattern in the floor, concluded that it looked as though, were a flask made for it, or, rather, a drag, used in connection with the cope, the pattern could be molded more quickly, thus making a saving; but actual practice developed the fact that it could be made just as quickly by bedding-in the drag half. So the new way was abandoned.

In some parts of the country, comparatively small castings are made in the floor. In speaking favorably of bedding-in work, I refer to the larger castings, though not necessarily referring to those extremely large. Referring to the city foundries as being obliged to resort to bedding-in work, the men employed in them are usually adepts in the system of bedding patterns into the floor.

In the accompanying sketches, Fig. 3 shows the sub-base for an engine, bedded into the floor, and the inside of it lifted out by the use of anchors. Perhaps some will call them carcasses, others grids, as I have heard all these names applied to them.

The pit being dug the required depth, a cinder bed, *A*, is put in, with gas pipe running above the floor from it for carrying off the gas. Sand is rammed on the cinders to the required hight, shown at *B*. This sand is leveled off, and a light coating of sand riddled on. The pattern is then set on this bed, and lightly rapped down, and then lifted off. Where the chipping pieces come, as at *T*, the sand is dug away to conform to the general outlines of the pattern, also where the bead runs around the top of the casting. A coarse vent wire is next used, and the bed is vented down to the cinders.

Molding sand is now riddled on to a depth of some ⅝ inch, being leveled off evenly in thickness. About the same amount of facing sand is riddled on top of it. The pattern is now placed on this bed, and rapped down as near as possible ¼ inch. The pattern is now staked at the corners, then removed, and the bed is gone over with a fine vent wire, the fine vents running down to connect with the larger ones referred to. The face of the mold is now finished to a certain extent, being gone over with the hand and any irregularities felt are attended to, also all vent holes are stopped up. The pattern is now replaced and tucked up around the outside with facing. Pig iron is placed inside of the pattern to keep it in place while the sand is rammed around it, the stakes being pulled up. Openings shown at *E*, Fig. 2, are rammed up and struck off flush with the plate of the ribs *K K*, thus forming the joint between these ribs at *H H*, Fig. 3.

The outside is then rammed up to the seat of the cores for the runners, as *c c*, which seat is made by sweeping a level place for the core to rest on at the required hight. Gate-sticks *E E* are then set, and tie-braces, as *F F*, are placed, held in place by pins, which are removed as the sand reaches them. As each ramming is finished the pattern is faced for the next. On one side of the pattern, not shown, are loose pieces forming two pockets on the outside of the casting. These pockets are well rodded and vented, and the patterns for them are drawn in after the main pattern is drawn. The outside being rammed up, the joint at the top is struck off.

Some ¾ inch of facing sand is now spread over the inside of the pattern, and on joint *H H*, tie-braces having been removed. Anchors, such as seen at *I*, are next placed on this bed, and gently rapped down to a bearing. Three anchors are used to lift out the inside. The rods *J J* are screwed into them. The cope is next tried on and located. In case any rod is too near, or interferes in any way with the bars of the cope, it can be easily bent to one side, and no trouble will be experienced. The cope is now removed, and the inside of the pattern is rammed up, being vented after some 6 inches of sand is rammed in, cinders being put in at this point after venting in such a way as to form pockets. At the right time tie-braces are put in place and the whole is then rammed up level with the outside, facing sand being used only in front of the gates on the sides. The cope is now replaced. Gate-sticks and risers are set and rammed up.

I will call attention to a piece of plank, *E*, Fig. 4, running under the corner of the flask. In case the cope is really smaller

than wished for, and if one is afraid that in weighting there is danger of crushing or caving in the sides of the mold by overweighting, pieces of plank or board placed under the corners will be found a safeguard against such an accident. If you cannot get a stake in the corner of the flask, nail a cleat on the side and let the stake bear against that. When trying on the cope, rap it down to a good bearing. Do not let it bear on the corners and not in the middle or *vice versa*. Be sure and have a good bearing and a good joint. It makes lots of difference, but yet do cinder pockets to bring up, and carry off the vent or gases.

As everything is ready, the crane is hooked on, and, as the strain tightens, four men stationed at the corners pound down on the gate-sticks, thus rapping the pattern down as the cope is hoisted.

In regard to anchors, it is not always necessary to have a pattern for them. Many a molder, if given a pattern, will with gate-cutter and trowel cut out a mold for an anchor good enough for the purpose. In making anchors do not have them come too close to the pattern. As

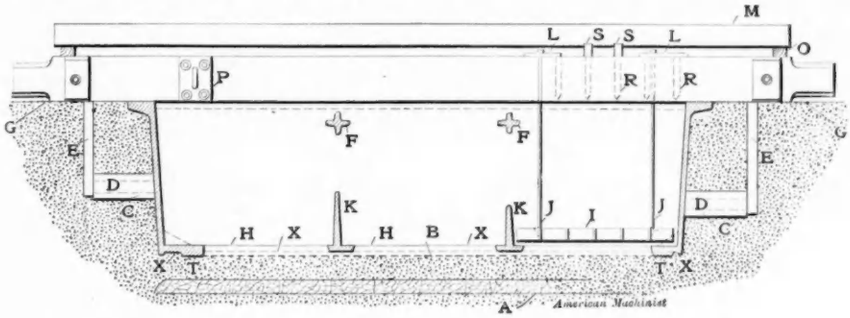


FIG. 3. SECTION OF MOLD WITH ENTIRE PATTERN BEDDED IN THE FLOOR.

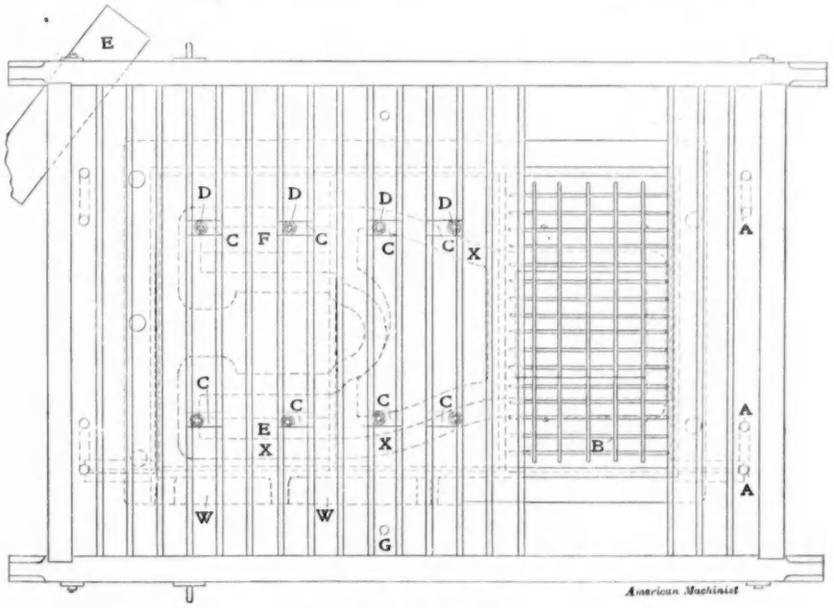


FIG. 4. THE COPE.

not wear out a trowel slicking a joint. If for any cause there seems to be a possibility of a job straining out at the joint, lay some pieces of pig iron a few inches away from the side and ram in sand between.

The cope being rammed up, pieces of iron are dropped down over the ends of the bolts *J*, with the ends of each resting on two bars, as at *c c c*, Fig. 4, and *L*, Fig. 3. As there are slots in these, allowing them to be moved back and forth, a washer is dropped on the bolt and the nut run down home and tightened. When ramming up the cope at each corner of the pattern, a gate-stick is rammed up, set on the pattern. A heavy vent wire is punched down through the cope to the the sand around them gets hot they expand, yet your casting is shrinking, so make allowance enough. We make some to within ¾ inch and some as near as ½ inch.

I have used the above to illustrate anchoring out the inside of patterns instead of making them in a flask and cheeking them off. In many cases it pays to take a pattern and make a core in the pattern at the deepest part that is to be lifted out. The core need not be very thick, and being fastened up to the cope, serves for an anchor to lift the sand. Especially is this useful in a deep, narrow pocket, which kind of pocket often scabs unless great care is taken for the vent to escape.

A casting of this kind, if made by a careful, painstaking molder, is quite sure to be a good job; but if made by one of the kind of molders that as long as a job will just pass "it's good enough," is pretty sure to have the under side looking like some parts of the country—humps and hollows, or hill and dale.

Patent Application of a Deceased Inventor.

On March 10, 1900, an application was received at the Patent Office, executed February 23, by W. W. Lewis, for an invention relative to a steam engine. After the application was filed it came to the attention of the Office that the inventor had died March 1, and the Office took the position that as the application was not by the party authorized by the statute and rules of the Office, it should be stricken from the files. On the day that the application was filed there was also offered for record in the Office an instrument dated the same day, whereby W. W. Lewis transferred all his right, title and interest in the patent to Eugene L. Lewis as trustee, and the request was made that the patent be issued to the said assignee. The patent was issued in the month of April, and no further action was taken in the matter until the latter part of September when the Examiner wrote a letter to the attorney of record stating that he had been informed that the inventor had died on March 1, 1900, and that therefore the attorney had no power to take out the patent when the case was filed and that it would be necessary for the administrator to file a new application. The Commissioner takes the stand that, as the inventor in the case died before the application was actually made by depositing the papers in the Patent Office, the application should be considered as not having been properly filed.

The fact that the application was assigned before the filing of same and before the inventor died, did not seem to change the situation, as the statute is positive that only an executor or administrator can apply for a patent in the event of the death of the inventor. If in a case of this nature the executor or administrator refuses to carry out the contract with the assignee and to reassign to him, the Patent Office has no jurisdiction in the matter, the proper remedy being found in the courts, and the assignee should go to a Court of Equity and compel the administrator to make the proper assignment. As the application was not made in accordance with the rules and statutes of the Office, it was stricken from the files.

A. F. TENNILLE.

A Wisconsin cat lately jumped into a flywheel 12 feet in diameter and making 87 turns a minute. It was 2½ hours before the engine could be stopped, when the cat was still alive.

Graphical Solution of Certain Equations.

BY ROBERT A. BRUCE.

In No. 38 of the "American Machinist" a graphical method of solving a simple case of the equation $y = k\,x^n$ is suggested by Mr. A. E. Dixon. Equations of this type occur so frequently in engineering calculations that the following perfectly general method of solution may be of interest. The solution proposed covers all values of the index n whether positive or negative, integral or fractional.

Referring to Fig. 1, take lines $O\,P$, $O\,Q$, subtending any convenient angle at O. Make $O\,P = n \times O\,Q$. Join P and Q. Apply a logarithmic scale with its edge along $O\,P$, and so that the values of the readings ascend towards P. By means of the scale locate the points A, B, C, D, etc., giving the values of x for which y is to be found. Calculate one value of y corresponding to, say $x = A$, draw $A\,A_1$, $B\,B_1$, etc., parallel to $P\,Q$, thus obtaining on $O\,P$ a series of points A_1, B_1, C_1, etc. The values of y may now be obtained by placing the logarithmic scale along $O\,P$ so that the scale reading at A_1 agrees with that calculated, and the values of the points B_1, C_1, D_1, etc., may now be read directly on the scale giving values of y corresponding to values of x located by B, C, D, etc.

In the case of a positive index, in applying the logarithmic scale to $O\,P$ the values must *ascend* from O to P, if the index is negative, the values must *descend* from O to P, or what comes to the same thing must *ascend* from P to O. Those who followed the articles on logarithmic cross section paper will have no difficulty in seeing that a single oblique line drawn at the proper angle across the diagram effects the same purpose as this construction.

For many purposes the scale engraved on the slide of an ordinary slide rule is sufficient and the subdivisions are of necessity much closer than those of logarithmic cross-section paper. It will be found well worth while to copy from the largest slide rule procurable a logarithmic scale and engrave it on a strip of opaque white celluloid. Such a scale is invaluable for office use, when the many purposes to which it may be put are once recognized. In order to make the foregoing construction quite clear, the scales shown in Figs. 1 and 2 are represented as they would be used in solving a definite problem.

In Fig. 1 the problem is as follows: The resistance of a ship of 500 tons displacement is 2,200 pounds; required the resistance at the same speed of ships of 400, 450, 550, 600, 650 and 700 tons displacement. The formula is here

$$y = k\,x^{\frac{2}{3}}$$

where y is the resistance in pounds, x the displacement in tons and k a constant, which in this case $= \frac{2200}{(500)^{\frac{2}{3}}}$ $O\,P$ is now made equal to two-thirds of $O\,Q$, and the points locating the values of x are found by applying the scale as shown. The corresponding points are now found on $O\,P$ and the values of y are read off by applying the scale as shown, so that 2,200 coincides with the intersection of the line from 500 with $O\,P$.

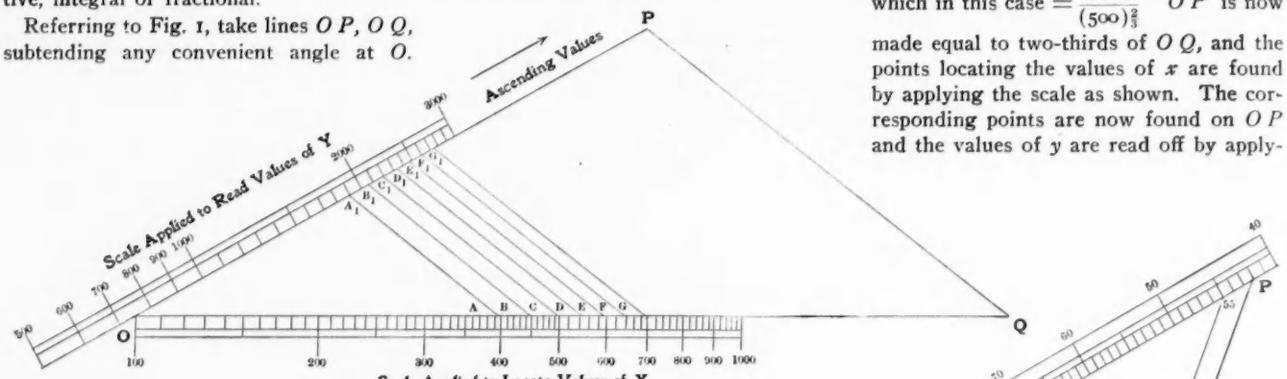

P
Ascending Values
Scale Applied to Read Values of Y
O
Q
A B C D E F G
100 200 300 400 500 600 700 800 900 1000
Scale Applied to Locate Values of X

Fig. 1 Index Positive.

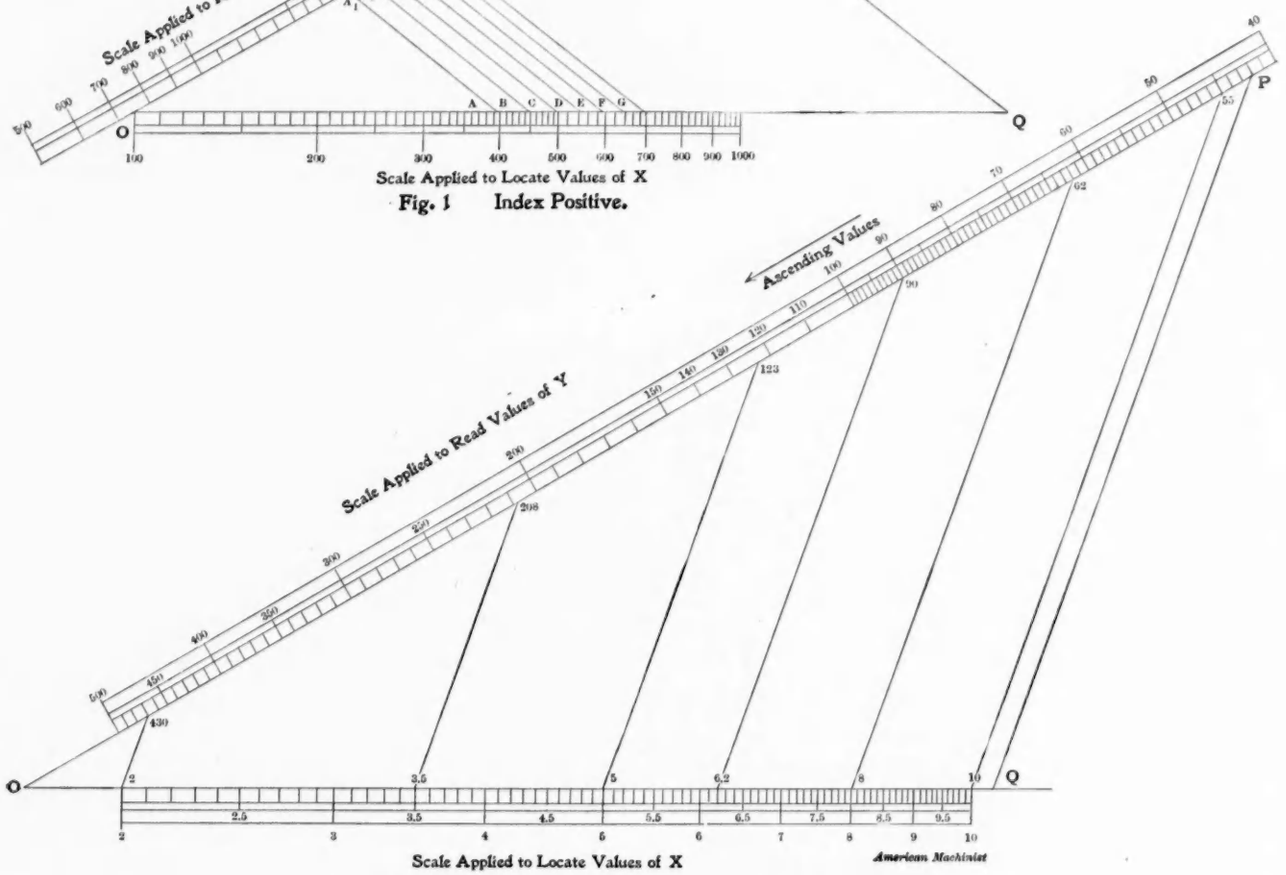

P
Ascending Values
Scale Applied to Read Values of Y
O
Q
2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5 8 8.5 9 9.5 10
Scale Applied to Locate Values of X
American Machinist

FIG. 2. INDEX NEGATIVE. GRAPHICAL SOLUTION OF EQUATIONS.

In Fig. 2 the problem concerns the adiabatic expansion and compression of air. The formula here used is

$$y = k\,x^{-1.41}$$

where y is the pressure above a vacuum in pounds per square inch and x is the volume in cubic feet; k is known if the volume corresponding to some definite pressure is known. Thus suppose that we have 6.2 cubic feet of air at a pressure of 90 pounds above vacuum and that we re-

quire the pressures when the same air is expanded or compressed adiabatically to volumes of 10, 8, 5, 3.5, and 2 cubic feet. Proceeding as in Fig. 2, OP would be made equal to 1.41 times OQ, and in applying the logarithmic scale to read off the answers the point indicating 90 would be placed to coincide with the extremity of the line from 6.2. As the index is here negative the scale would be applied so that values decrease from O to P.

New Brompton, England.

American Competition in England.

In the course of an article on the above named subject, "The Engineer" speaks as follows:

"It is, we think, right that the true position of the English manufacturer should be stated. Very hard things are being said of him by those whose ignorance is so great that they can make sensational statements in advance of the fact without offence to consciences which are in fairly good training. The form usually taken by the accusation is that the British engineer, bridge builder, ironmaster or manufacturer is ruining the trade of the country by his sloth, his incompetence and his greed. There is no mincing matters. The United States manufacturer is everything the Briton ought to be and more. We are tired of refuting these untruths. Some of them are, no doubt, the product of ignorance and an ardent and honest desire for the welfare of this country. Others are the result of a deplorable pessimism and utter want of faith in the people of Great Britain. For the most part, however, they seem to be the result of that demand for sensationalism which is degrading the English press to the level of the worst portion of that of the United States. 'Half a lie is better than no news,' seems to be the motto of too many of our daily contemporaries. The very paper which is most persistent in its attacks on those who go to the United States with orders is printed on machines made by an American firm in this country, and driven by electrical plant supplied from the United States. But enough of this; let us consider what is the truth about British manufacturers and foreign orders.

"Nations, like individuals, have limited powers. The productive capacity of every nation is fixed by certain conditions. These conditions may be altered, but the process can never be very rapidly carried out. One of these conditions is the amount of labor available. Now a glance at the reports of any of the trade unions, including engineers and boilermakers, platers, riveters, etc., will show that nearly every man on the books is at work. Not more than 2 or 3 per cent. are idle; or, at all events, drawing 'unemployed pay.' Again, if we go a little further, it will be found that thousands of these men are now working overtime, and have been so working for months past. The great locomotive building firms are turning out engines as fast as they can. The same statement is true of all departments of the engineering trade. The English manufacturer does not go about the country boasting of his business. But the moment the American manufacturer proclaims on the housetops that he has got a big order, the more or less ignorant daily press is stupefied, and in a wild panic begins to call out, French fashion, that the country is betrayed. Let us apply all this to the case of South Africa. It will be admitted, we think, that plant and machinery of all kinds are wanted there in quantities. If the orders for locomotives, carriages, bridges and rails cannot be placed in this country for prompt execution, is Africa to go without? The sensible answer is, certainly not. If, again, the government can obtain these things from the United States for a very much smaller price than that for which they can be had in Great Britain, is that fact to have no weight? Some well-meaning people seem to think that the British manufacturing engineer is little better than a congenital idiot. He will leave his works idle rather than take a fair price for what he makes. The English manufacturer's real standpoint is entirely different. If he asks £15 a ton for bridge work, and is told that his American rival is prepared to do the work for £12 a ton, his answer is simply, 'So much the better for the purchasers. My place is full of orders for the next twelve months at £15 a ton. Is it likely that I shall turn this out to underbid the American?' Those of our readers who are not conversant with the facts may rest assured that there is a side to British manufacturing life that the public is not permitted to see. The orders that are allowed to go out of this country until their value has been fully considered represent next to nothing in the great bulk of our trade. It is beyond all question that now and for some time past the productive powers of this country have been taxed to the utmost. What, for example, does a demand absolutely unprecedented for foundry coke mean? Why is it that machine tool makers have been simply overwhelmed with orders?

"We have heard it said that if Englishmen had displayed proper energy they would have so far amplified their means of production that they could have taken all orders and supplied every want. Those who write or speak in this way are densely ignorant of the enormous development that has taken place within the last few years in every department of industry. Capital has, in many cases, been poured out like water. The number of hands employed has been, in a multitude of instances, doubled, and the output per man has been largely increased. Those who believe that no progress is being made should visit some of the great manufacturing towns. It is quite true that more might have been done. It is certain that antiquated works and hoary methods of doing a moss-grown business are yet prevalent enough, but it is very far from certain that more could have been done in the investment of capital with any advantage. It is not in any way clear that the further expenditure of millions would have proved remunerative. Trade, it must be remembered, rises and falls. We have had very good times; but there are not lacking evidences that the turning point has been reached, and that trade will not continue quite so active as it has been. Order books are no longer filled to overflowing; and although just now it may be difficult to obtain locomotives or railway rolling stock, or steam engines, or dynamos, it by no means follows that a similar difficulty will exist in the spring of next year. Even in this matter of developing the means of production the British manufacturer is wiser than his critics suppose.

"Lastly, we may explain that with legitimate intelligent criticism of the British manufacturer, his ways and methods, we have no fault to find, nor, we believe, does he resent it. Such criticism ought to be, and no doubt is, useful. There is plenty of room for it in many places. But for a so-called criticism which is founded on error, and takes the form of a glorification of the foreigner and the depreciation of our own countrymen, we have nothing but censure. It is, happily, usually so absurd that it does no harm even in our foreign markets."

The Chips They Make in England.

The chip shown in the half-tones, both being from the same chip, was made in the shops of Albert Herbert, Limited, Coventry, England, the photographs being kindly sent us by Mr. A. G. Marston. The chip was made on an Alfred Herbert hexagon turret lathe, feeding away from the chuck, the material mild steel. Our readers will doubtless some of them be glad of the opportunity of reasoning out or of guessing the other conditions that produced such queer chips.

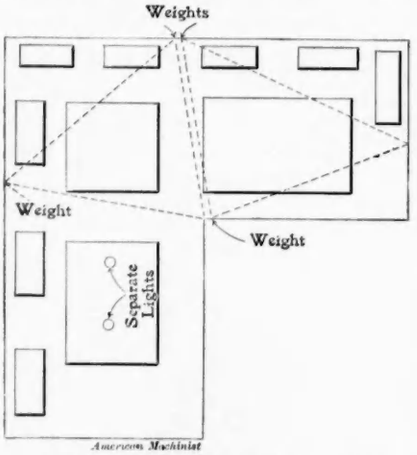
Letters from Practical Men

Rig for Hanging an Incandescent Lamp—An Improvement.

Editor American Machinist:

The article by Mr. Edgar H. Berry, under the above title, in the "American Machinist," No. 44, was of considerable interest to me. In our drafting room each detail table is provided with a separate light. The center of the room is occupied by the cases for holding the drawings, and the top of these cases is used for laying reference drawings on. The center of the room was not very well lighted, and when I saw the above article I decided to try it. So I arranged two of the triangles in the manner shown in the sketch. By having a light for each triangle, it will be seen to cover all of the cases in a very neat manner.

Mr. Berry mentioned having the pulley higher than the hooks, so as to allow the slack not to interfere with the head. I arranged this rig a little differently, so as to get over this objection. Instead of using hooks and fastening the cord into them, I used three pulleys for each triangle, and passed the ends of the cord through the end pulleys and fastened them to weights. It will now be seen that, no matter where you place the light, it will always maintain its normal hight, owing to the weights taking up the slack. I hope the suggestion of the weights may prove as useful to someone as the suggestion of the rig itself did to me.



RIG FOR HANGING INCANDESCENT LAMP.

H. D. Van Doorn.

Providence, R. I.

A New Marking Machine, and Experiences in Developing it.

Editor American Machinist:

We have recently constructed a machine for rolling the firm name and a figure on our combination center drills, and as the principle involved is, I think, new, and as we have found it very rapid in its operations and easy on the dies, and as it works so well generally, we thought it would be of interest to the readers of the "American Machinist."

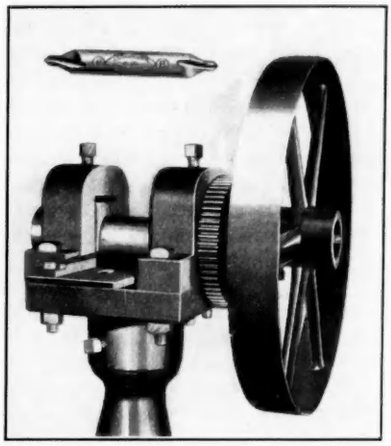
The principle involved is illustrated in Fig. 1 in the sketch. The roll is made of steel, hardened and ground, and is made adjustable for hight, in housings attached to the machine bed. The die is held stationary on the bed, and is adjusted laterally by four set-screws. The figure to be marked upon the work is raised on the curved upper surface of the die. The radius of this curve equals the radius of the roll plus the diameter of the work. In operation the roll revolves continuously in the direction of the arrow. The work is placed upon a table slightly lower than die, with the ends against the guide; then the whole row is pushed forward while each piece is caught by the roll and rolled over the figure on the die, dropping off the opposite side and falling into a box. The step *a* shown on the die is for the purpose of lining the work just before entering over the die.

The machine in itself is very simple, but we found a number of surprises in making the dies. The way we went about this was to make a hub for each die required. This hub, it will be seen, requires a face just the reverse of the die, with the letters and figures sunk instead of being raised. This was very easily made. The blanks were got out as in *b*, Fig. 3. The curve of the face was accurately turned on a special arbor, Fig. 5. The hub block *b* was soldered in a slot planed in the arbor. The small plug *f*, held by the set-screw, being opposite the hub block *b*, is used to help in measuring the diameter, the end being turned off at the same time with the hub block *b*. The hubs, after being turned and polished, had the letters stamped and figures engraved upon their faces. The idea was to force these hubs by means of a hydraulic press into the blocks, and so raise the figure in the die to correspond with the impression in the hub; and right here was where the trouble commenced. The stock would go down all right, when there was pressure enough applied, but to have any of it come up was another matter.

We decided that the action was something as represented in Fig. 4, in which *d* is a punch and *g* a block of steel into which we try to force the punch. We found that we not only got the impression of the end of the punch in the block, but the adjoining stock was drawn down very much the same as though it were a piece of rubber, although of course not to the extent shown in the illustration. Now in the die, Fig. 2, *e e e e* represent the raised letters. These raised portions being so small compared with the portion forced down, practically the whole thing went down together.

We started with the die flat on the top, and after about six operations of forcing and annealing, during which operations the die was reduced in thickness fully ½ inch and the figure was raised very little better than after the first operation, we decided that something else must be done. The die sinker thought it would help to make the surface of the die at the start convex instead of being flat. We shaped the die block as in *h*, Fig. 4, and tried it six times more without much better results. The die sinker then suggested engraving a groove all around at the base of each letter and figure, as shown in Fig. 2. This seemed to be what was required. The figure then came up with very little trouble. One thing that seemed remarkable to us was the amount of torture that one of these die blocks would stand. Most mechanics would expect to see them go to pieces with one-half the punishment they got.

Returning to the machine shown in the half-tone, it will be seen that the range of diameters of work allowable with any given die depends largely upon the width of the figure to be rolled, or, in other words, the distance this figure will lap around the work. Where there is only one line of fine type the die will answer for about all diameters less than the largest it was designed for. It will be seen that, for plain work, one roll will answer for all sizes, but a roll could be made with grooves to allow for projecting parts on the work. In adjusting the dies under the roll we use rings slipped over the roll. These rings are bored to fit the roll and turned outside to correspond with the circle of the die. There are two rings for each die. A pair of rings are slipped on the roll and placed a distance apart to suit the plain part of the die outside the figure; now the roll is forced down, bringing the rings in contact with the concave surface of the die, which locates the die quite accurately. The set-screws are then brought up to bear against the edges of the die and tightened slightly. We now run a piece through, after which the set-screws usually have to be adjusted slightly. Now the only trouble is to get work enough to keep it running. It is the most rapid thing of the kind I have ever seen.



A SPECIAL MARKING MACHINE.

Providence, R. I. J. T. Slocomb.

Time and Cost Keeping in a Small Shop.

Editor American Machinist:

The following method of keeping cost of labor and material was introduced in our shop about two years ago; since then it has given good satisfaction. The system is particularly applicable to small shops where the all-round foreman is expected to send the orders in to the office with complete record of time and material used on work.

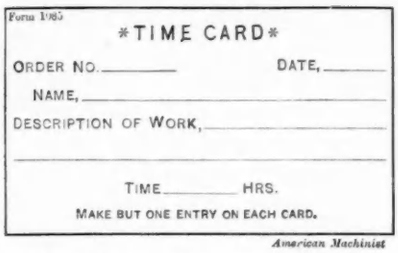


FIG. 1. TIME CARD, REDUCED SIZE.

The time cards used are as shown in Fig. 1. When these cards are handed in for the day, the time-keeper transfers the number of hours each man has worked to the time-sheet and then passes them along to the foreman, who posts them in his book, as shown in Fig. 2. In this case the book is a cabinet with the order number marked on a slip of paper and pasted under the pigeon hole. When the order is completed, the foreman simply takes all the cards from the pigeon hole marked for this order, separates the time for each piece as desired, and transfers it to the order, also any material slips filed with the cards, after which the orders go in to the office to be figured for cost and filed for reference. EDWARD H. DUTCHER.

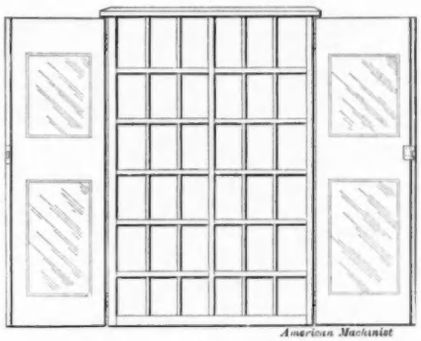


FIG. 2. TIME-CARD CABINET.

A Non-wabbling Wabble Drill.

Editor American Machinist:

An article by Professor Sweet, on page 37 of the "American Machinist" for August 31, 1899, shows a wabble-drill, so called, which has, at first glance, somewhat the general appearance of one patented by myself several years ago—although a closer inspection shows it to be an entirely different affair. In my device, however, the old wabble principle of allowing the drill to bend sideways if long and springy, or to shove the work around with a sort of planetary motion if short and stiff, does not appear, as does not the swinging of the drill shank in the spindle socket described by Professor Sweet.

On the contrary, the stem of the drill itself is truly cylindrical and revolves all the time about its own axis, while the work remains stationary.

In Figs. 1 and 2 are shown, respectively, a side view and edge view of this drill as it begins its work when lowered into the bottom of a hole drilled in the ordinary way. As soon, however, as the short side of the swinging cutter, which has its vertical axis eccentric to that of the drill, strikes the conical bottom of the hole it swings itself over by reason of its contact therewith (being smoothly rounded off), thus allowing its other side, carrying the cutting edge, to cut into the cylindrical wall of the hole and produce the recess *d*—all as shown in Fig. 3.

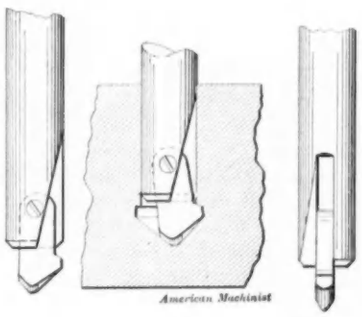


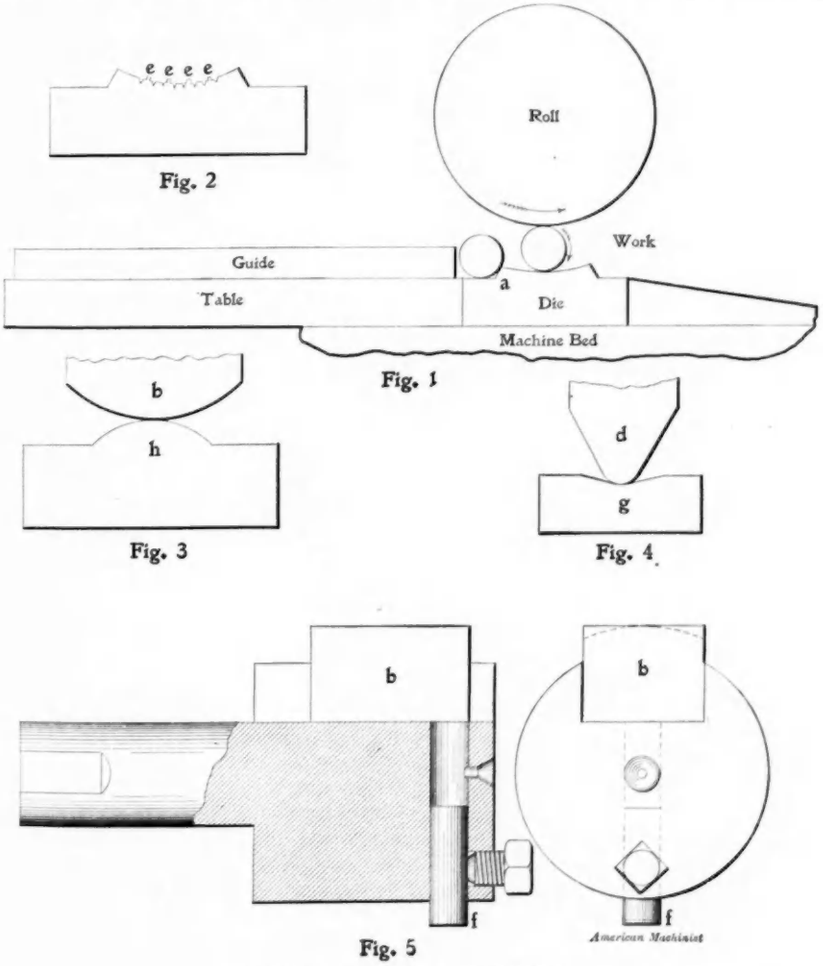
FIG. 1. FIG. 2. FIG. 3.

A NON-WABBLING WABBLE DRILL.

This tool has been in practical use for a number of years, and has always worked well. It enables the work to be firmly clamped in place and operated upon with a stiff, true drill-stem, revolving upon its own axis and bringing no side stresses upon the drill-press spindle. The little piece forming the cutter is, moreover, very easily and cheaply made and kept in order. It can obviously be arranged for cutting a groove of any width desired.

There is no question about the usefulness of tapped holes, with a clearance groove of the kind under consideration, as the thread can be tapped cleanly down into the groove with less danger of breaking taps and with no uncertainty as to the depth of the threaded portion of the hole. The system is especially good where the depth of the hole has to be somewhat limited without much, or any, clearance space under the end of the stud or bolt.

An inspection of the patent above mentioned will show an amplification of the drawings annexed hereto in the form of a



MARKING-MACHINE EXPERIMENTS.

reversible drilling tool, swinging in a shank inserted in the drill spindle and capable of performing different functions at its different ends. As there shown, the grooving tool described herein constitutes one of the ends of the reversible tool in question, the other end being, in this particular case, an ordinary drill of tapping size. This, however, as Kipling would say, is another story. The use of such a tool of course allows the completion of the hole at practically one operation; that is, by simple manipulation, without changing the position of the work and without withdrawing and inserting tools in the drill spindle.

This device (either as a wabble-drill merely, or in its complete form) has never been put upon the market, simply because the writer has had no time to attend to its commercial development, through press of other work. It has, however, served an excellent purpose as a working tool in the shops under my control.

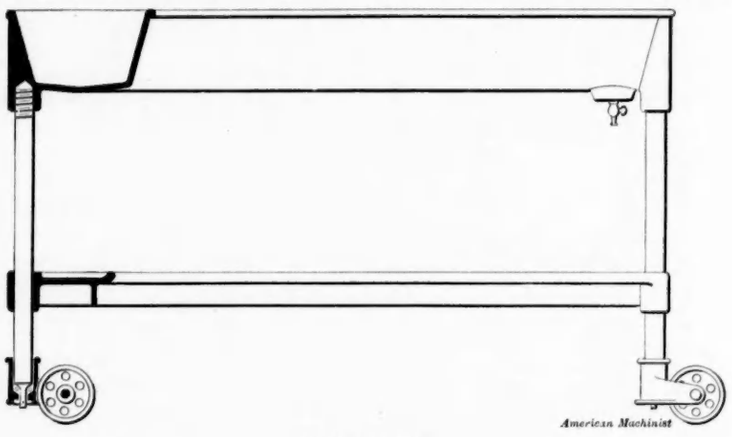
Although I do not by this publication abandon my exclusive right to the manufacture of this tool, any reader who wishes to make such a tool for his own use is at liberty to do so. OBERLIN SMITH.

Bridgeton, N. J.

A Lathe Pan.

Editor American Machinist:

In your issue of November 8 Mr. Arthur H. Gang submits a home-made form of chip box for lathes. After mentally running the gamut of sinks, soap boxes and time-honored, oil-soaked troughs, which have done duty under lathes for the present generation of mechanics, one wonders why a properly built lathe pan of universal application has not come into existence before.



A LATHE PAN.

I see no objection to letting Mr. Gang into the constructional secrets of such a pan, now being regularly manufactured. In it the aim has been to combine portability and ease of handling with generous holding capacity. The construction favors knocking down for transportation and quick setting up. Screwing the legs in or out of the upper pan levels them all to secure fair bearing on the floor, and set-screws in the lower pan not only hold it at the proper hight on the legs, but prevent them from losing the adjustment above referred to.

This lower pan, or shelf, is very handy for the usual lathe extras, face-plate, follow-rest, chuck for shafting trap By taking a little care to make the hight of the upper pan just what will come in place under the lower side of the lathe bed, every chip that comes down is caught. Nine-tenths of these chips are made at or near the headstock end, and of course drop in that end of the lathe pan, and where frequent alternations of iron and brass work occur it suffices for all practical purposes in keeping the chips separate, to simply turn the pan end for end. A temporary partition can be placed across the pan, if necessary, to effect complete separation. The strainer and draw-off cock complete the arrangement for drawing the oil or compound from the chips, so lubricant may be used again. Notice that the wheels are large enough for easy propulsion, and the balls which provide a quick swiveling feature for casters are held in retainer cages, so they can be inserted or removed as a unit.

Of course, these features are patented, but aside from this, and considered simply as a proprietary article in place of those conjured up at home, it would seem to merit consideration. The machinist trade is so minutely specialized to-day, and has advanced in this country by accepting aids in specialties as they appear and when they are proven good, that the advice of our friend, Chordal, with regard to mandrels seems to have a broader meaning. He says, "Don't dream of making such things; go and buy them from someone fixed for making them."

THE NEW BRITAIN (CONN.) MACH. CO.
ROBT. S. BROWN, Secy.

Carbolic Acid for Hardening Tool Steel.

Editor American Machinist:

Apropos of the experiments now being undertaken with improved methods of tempering tools, I am reminded of an article in the "Revue Industrielle." An English mechanic sent me a clipping of a translation of it, which I have mislaid, and I have been unable to get at the article in the original. Briefly, it is a description of a number of experiments upon steel tools hardened in carbolic acid, and a great deal is claimed for the resulting benefits of this method. Personally, I do not have opportunities of thoroughly testing this method, and I merely suggest the idea to those of your readers who may have time for investigation, or who may know more of the article in the "Revue Industrielle," or the practical possibilities of the scheme.

Perhaps it has already been examined and the investigation thoroughly ventilated here; but, beyond the belief that the use of acid has a more drastic effect, any information would be novel to myself, and doubtless equally interesting to a majority of your readers. Then, again, it may be well known to the manufacturers of tool steel, who may refrain from advocating its use, or that of any like treatment, on the ground that competitors might aver that steel requiring such measures was necessarily inferior to other tool steel, etc. For myself, I simply hold that it is advisable to favor the steel, and if any cheap substance can be applied in the process of hardening that will lengthen the useful life of the tool, such treatment should at least be as well known as possible, and then the user can take his choice between that and the more common method.

"Q."

An Adjustable Parallel Block.

Editor American Machinist:

The working drawing which I send you of an adjustable parallel block is not new. Similar ones may have been seen and used by many of your readers, but this is offered for those of the craft who are not familiar with such a device. I have worked in many shops and have never seen another pair of adjustable parallel blocks but those of which I send the drawing. It seems so strange that more of such tools are not in general use.

The block, as shown, is 7 inches high, 18 inches long and 2 inches thick. If the whole length of the screw is used, the extreme hights are 5 and 9 inches. To come down to the lower dimension, the block must be so placed that the upper part will overhang the platen; otherwise the lowest practicable hight will be 6⅜ inches. The faces are planed so that the upper block slides on the lower quite easily, the dovetail serving principally to always keep the blocks together. The lugs for the screw are cast on the side of each piece. These lugs may be drilled with a long drill when they are close together, and if a long tap is used, the tapping may be done with the lugs as far apart as the length of the tap will permit, the upper lug serving as a guide for the shank of the tap, and thus

keeping the two holes in line, so that the screw will work all right. It is well to use a screw of a pitch coarser than standard, and a square thread is to be preferred. The screw in the drawing is ⅝ inch in diameter. Two or four or more should be made at once. A. M.

The Taylor-White Process of Treating Tool Steel.

The "Mechanical Engineer" (of Manchester) for November 17 contains in full the specification and claims of the British patent covering the Taylor-White process of treating steel, an exhibition of which steel formed the subject of an article in our issue No. 33. Inasmuch as the American patent is at this writing not yet issued and we have no other available source of information, we make the following extracts from our contemporary's reprint of the British patent:

"The invention relates to the manufacture of tools for cutting metals, or similar uses where the tool is highly heated in performing its work. The object of my invention is to provide a tool capable of working at a higher temperature, and, consequently, of doing more work in a given time, or running at a higher cutting speed than are tools as heretofore made.

. . . . . .

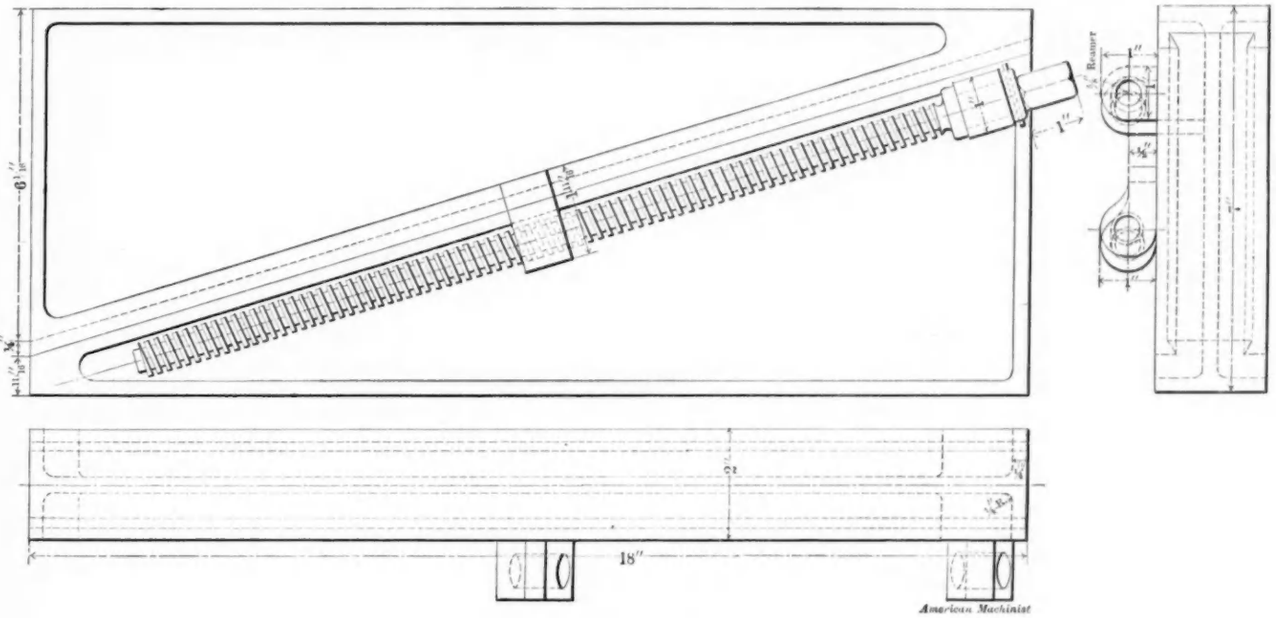
"In the treatment of both classes of steel [carbon and air hardening] it has always been recognized that what is known by overheating, either in making, dressing or treating the tool, is to be carefully avoided under penalty of most material injury to the tool, and the points at which overheating occurs are carefully studied and well recognized in the trade. In the case of the air-hardening steels the maximum temperature considered permissible is that indicated by a bright cherry red, which color I have found by careful observation to indicate from 1,500 to 1,550 degrees Fahr. Above this temperature tools made of air-hardening steel rapidly deteriorate, and all makers of such steel are careful to caution their customers not to heat such tools above this temperature.

. . . . . .

"My invention is based on my discovery that while it is true that tools made of air-hardening steels all rapidly deteriorate at temperatures in excess of a bright cherry red (though it must be understood not all at the same temperature), it is also true that when air-hardening steels are made with certain constituents in ascertained proportions this deterioration only prevails during a limited range of temperature above the bright cherry red—that is to say, from about 1,550 to about 1,700 degrees Fahr. (corr sponding to a light salmon color)—and that above this range of temperatures, which I call the 'breaking-down point,' and from 1,725 degrees Fahr. up to a temperature at which the steel softens or crumbles when touched with a rod (approximately 1,900 to 2,000 degrees Fahr.), the efficiency of such tools—that is to say, their cutting speed, and also their uniformity in efficiency—is greatly increased, and largely so in proportion to the degree of heat to which they are raised. This is so much the case that their cutting speed may be stated to be from 1½ to 2½ times that of the tool heated, as heretofore, to temperatures below the 'breaking-down point.'

"In order to provide an air-hardening steel suitable for my treatment it is necessary that it should be compounded with chromium in the proportion of at least one-half of 1 per cent. and another or other members of the commercially available members of the chromium group of metals in the proportion of at least 1 per cent.—that is to say, with either tungsten or molybdenum or of a mixture of tungsten or molybdenum in the proportion of at least 1 per cent. While I have found that to produce a markedly beneficial result from my treatment it is necessary to use at least one-half of 1 per cent. of chromium in combination with at least 1 per cent. of tungsten or molybdenum, or of a mixture of these substances, I have also found that materially better results are secured where chromium is present in the proportion of 1 or more per cent. and tungsten in the proportion of 4 or more per cent.; or, in the alternative, molybdenum present in the proportion of 2 or more per cent.; or, again, tungsten present in the proportion of 2 per cent. or over, together with molybdenum in the proportion of 1 per cent. or over. My experiments have shown that, with respect to the cutting speed of the tool, molybdenum replaces tungsten in the proportion of about one to two, though it is proper to note that in other respects I find the tungsten steels preferable.

"I have not found any very material difference in the cutting speed of the tool in cases where the chromium and tungsten or molybdenum are used in excess of the percentage last given, except that for cutting very hard metal I have found a tool composed of steel having not less than 3 per cent. of chromium and not less than 6 per cent. of tungsten, or, in the alternative, not less than 3 per cent. of molybdenum, to have especial value. With regard to the carbon contents of the steels used by me, I have not found it to be a material factor. I have worked with steels containing carbon from .85 to 2 per cent. without noticeable difference in the char-



ADJUSTABLE PARALLEL BLOCK.

acter of the tools produced by my treatment.

. . . . . .

"The efficiency or cutting speed of tools treated by my process increases with the temperature to which they are subjected above the 'breaking-down point.' This is noticeably true from temperatures of 1,725 to 1,850 degrees Fahr.; but when heated above 1,850 degrees Fahr., and from this temperature to the point where the steel softens or crumbles when touched, the increase in cutting speed of the tool is very striking, reaching its maximum at these high temperatures.

"While for cutting most metals, tools made and treated by my method work as well whether they are cooled from the 'high heat' to which I subject them rapidly or slowly, for cutting certain kinds of metals, among which may be mentioned, especially, hard metals, I have found that the tools can be run at a higher cutting speed when they are cooled rapidly from the 'high heat' to a point below the 'breaking-down temperature'—that is, below 1,550 degrees Fahr., or, preferably, below a bright cherry red. This is conveniently done by plunging the tool at its 'high heat' into a lead bath maintained at a temperature below the 'breaking-down point'; and after the temperature of the tool has fallen to that of the bath, it is taken out and cooled rapidly or slowly as may be desired. It is important, however, that in the cooling down of the tool its temperature should be either stationary or falling at all times during the cooling-down period after it begins to fall through what I have termed the 'breaking-down point,' and until it reaches 1,240 degrees Fahr., because the valuable properties imparted by the 'high heat' are impaired by even a slight and temporary raise in temperature within these limits and during the cooling down from the 'high heat.'

"In practising my invention, I have found it advantageous to treat certain tools, preparatory to subjecting them to the 'high heat,' by coating them with a protecting covering which at the 'high heat' will melt and cover the part of the tool being treated with a film which will exclude air or other gases which might injuriously affect the surface of the tool. A fusible slag I have found to afford the best coating for the purpose, and I have also found that where such a slag coating is used it is particularly advantageous to cool the tool rapidly from the 'high heat' to a point below the 'breaking-down point' by quenching it in a lead bath maintained at the proper temperature or in a blast of air. Suitable slags may be made of 2 parts powdered glass and 1 part clean clay, or of 2 parts powdered glass and 1 part river sand, or of 30 parts ordinary river sand, 10 parts soda ash, 10 parts fluor spar and 2 parts borax. The slags should first be fused into a glass which is powdered fine before use.

"Another discovery upon which my invention is in part based is, that the cutting speed of my tools treated at the 'high heat' is materially increased by holding the tool for several minutes at a temperature between 450 and 1,350 degrees Fahr.; for the best results, between 700 and 1,240 degrees Fahr. This can be effected by checking the cooling of the tool after its temperature has fallen below 1,350 degrees Fahr., and maintaining it at the desired point or points for the requisite time, or, preferably, by reheating the tool and holding it at the point or points determined upon. This supplemental treatment I call the 'low-heat' treatment, and it must be noted that in this 'low-heat' treatment the tools, if raised above 1,240 degrees Fahr., and from that up to 1,350 degrees Fahr., must be maintained at such temperatures for only a very short time; while below 1,240 degrees Fahr. no deterioration takes place by exposure to the chosen heat for a long time, and I prefer an exposure of at least five minutes with the lower range of temperatures. Even longer exposure is advisable.

"From what I have said it will be understood that when the 'low-heat' treatment is practised by checking the cooling of the tool from the 'high heat,' the tool should be allowed to cool quickly to a temperature below the 'breaking-down point,' and then cooled slowly while passing through the upper temperatures corresponding to the 'low heat' treatment.

"The beneficial effects of the second or 'low heat' treatment can be secured in measurable degrees by heating the tool in a lathe, the necessary temperature being attained by the friction of the chip on and above the cutting edge of the tool.

"In treating tools by my process the high heats employed have a tendency to slightly deteriorate the outer portions of the metal of the tool. Consequently it is advisable, if not necessary, that the deteriorated metal should be ground off after treatment of the tool and before its use.

"From what I have said it will be understood that my treatment consists primarily in treating tools made of air-hardening steel having the peculiarities of the composition specified, by heating them to temperatures above those corresponding to the 'breaking-down point,' and comprised within those specified as indicating what I call 'high heat,' preferably at the higher range of such temperatures. Secondarily, my invention consists in treating the tools after exposure to the 'high heat' to protracted exposure at temperatures comprised within the specified range of 'low-heat' temperatures, preferably at temperatures between 700 and 1,240 degrees Fahr. Another distinct step in my treatment consists in the rapid cooling of the tool from the 'high heat' below the breaking-down point.'

"I may mention, though this will be apparent to those skilled in the art, that the 'high heat' of my treatment can be taken as the last heat in forging the tool.

"It is well known to those skilled in the art that the accurate determination of the higher range of temperatures is a matter of considerable difficulty and of some uncertainty. The temperatures noted by me were ascertained with the greatest care, and by the aid of the most accurate pyrometer. The error, if any, in my stated temperatures will be found on the low side, and within, I am convinced, a range of not more than 25 degrees."

A Useful Arrangement of Formulas.

The New Britain Machine Company, of New Britain, Conn., have sent us a very useful blueprint table of formulas for the strength of beams under different methods of loading and a companion table of moments of inertia for the various sections. These tables are similar in form to those given in the pocket books, but they have the added feature of a column in which is given the logarithms of the numerical constants which occur in the formulas. As calculations of cases covered by the formulas are naturally made with the aid of logarithms, this feature saves the repeated looking up of the logarithms of these factors and must save considerable time.

A Novel Suit for Damages in Scotland.

Sheriff Boyd, Glasgow, has given decision in an action in which Andrew Falconer, blacksmith, 50 Queen street, Govan, sued his employers, the London & Glasgow Engineering & Iron Shipbuilding Company, Limited, for compensation in respect of an accident sustained under peculiar circumstances. He was engaged in the company's works at an anvil, when two of his fellow workmen, who were indulging in horse-play, stumbled against him and knocked him over a bucket of water, whereby his left leg was broken. From the effects of this accident he was totally incapacitated for twenty-four weeks. He pleaded that the accident arose "out of and in the course of his employment," and claimed compensation in consequence. The Sheriff finds that the accident did arise out of and in course of pursuer's employment, and ordains the respondents to pay compensation to him at the rate of 10s. per week for twenty-two weeks, or £11 in all. The respondents are also found liable in expenses.—"Iron and Coal Trades Review."

The steamship "Cowrie" lately made the voyage from Koetei, Borneo, to London, 9,250 miles, using only liquid fuel. She employed only six stokers instead of sixteen with coal. The oil consumption was 22 tons per day, against 35 tons of coal, and as a ton of oil occupies 35 cubic feet, while a ton of coal demands 45 cubic feet, the saving in bunker space was considerable. In loading, the oil was put aboard at the rate of 300 tons per hour. Oil at Borneo is $7.50 per ton.

Personal.

Thomas D. West, of Sharpsville, Pa., will deliver an address to the students of Cornell University, December 14, on "Characteristics of the Chemical and Physical Properties of Cast Iron."

W. S. Davenport, who has for some years had charge of the design of screw machines and screw-machine tools for the Brown & Sharpe Manufacturing Company, of Providence, R. I., has left there, and it is understood that he intends to engage in business for himself at New Bedford, Mass., in some line of automatic machinery.

H. P. G. Norstrand has resigned his position as superintendent of the Pennsylvania Boiler Works, of Erie, Pa., and has accepted a position in a similar capacity with the Abendroth & Root Manufacturing Company, of New York City. Mr. Norstrand entered his new work December 1.

Obituary.

Halcyon Skinner, an inventor who is said by the trade to have revolutionized the carpet-making industry, was accidentally killed by a train at Yonkers, N. Y., where he lived, November 28. Mr. Skinner was over seventy years old, and had been all his life connected with carpet factories in Yonkers and vicinity. His first invention was a loom in 1849. He was a practical mechanic and in responsible charge of the machine manufacturing department of a mill while still a young man.

The Cornell Society of Mechanical Engineers is a new society formed this fall among the students of Sibley College, Cornell University. The object of the society is to promote the interests of mechanical engineering among its members, to bring to their notice the latest phases of engineering practice, and to drill them in the methods of the larger societies. It has a membership of about sixty, and has been very successful thus far in its work. Several interesting papers have been presented before it, including one on "Steam Turbines" by Dr. R. H. Thurston, director of Sibley College.

Manufacturers.

Mr. Emmons, of Thornton, N. H., will erect a mill.

A factory will be erected for the Standard Brass Works, Detroit, Mich.

The Mayer Pottery Company, Beaver Falls, Pa., will double its capacity.

The Central Optical Company, Southbridge, Mass., will build an addition.

W. S. Griswold, Elyria, O., will locate a wood plaster plant in Flint, Mich.

R. D. Wood & Co.'s cotton mill at Millville, N. J., will be rebuilt in the near future.

The National Foundry Company, of Erie, Pa., is making improvements to its plant.

The Ideal Foundry Company, Milesgrove, Pa., is considering a location at Toledo, O.

A new mill is being erected by the Moses Brothers Grain Company, Great Bend, Kan.

The National Tube Company will, it is rumored, enlarge its plant at McKeesport, Pa.

The Meehan Boiler & Construction Company, Lowellville, O., will put up a new building.

A new mill building is to be erected for Meyer & Sons, Springfield, Mo., to cost about $12,000.

An addition, 35x140 feet, will be made to the American Glucose Company's plant at Peoria, Ill.

(*Continued on page* 48.)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant ; see p. 22.

Mfg.plants,space,powers,land. A.Ela,Boston.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Light and fine mach'y to order ; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

For Sale—2 H.-P. and 1½ H.-P. gas or gasoline engines. Box 1171, Springfield, Mass.

We want to build small tools for you ; price low ; write us. Box 92, AMER. MACHINIST.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

Storey's lathe tool holder, with self-hardening cutter, mailed, prepaid, 68 cents. Storey & Sons, Mt. Holly, N. J.

For Sale—Unbound back volumes of the "American Machinist," from Volume 7. A. F. Ward, Newcomerstown, O.

For Sale—Blueprints for 1¾ H.-P. gasoline automobile motor ; full size ; all details and dimensions ; $3. Address Box 95, AM. MACH.

Mechanical engineer has three valuable inventions, but no capital ; wants capitalists or manufacturers to join him or form a company. Box 94, AMERICAN MACHINIST.

Special machinery designed and built for the cheaper production of product ; machinery for screening, sizing, etc. ; experimental work at low cost. Beckley Perforated Metal Works, Garwood, N. J.

Wanted—30 in. or 32 in. lathe, 20 ft. between centers ; 3 ft. arm radial drill ; ½ in. to 2 in. bolt cutter ; keyseating machine ; 5 ton hand-power traveling crane, about 20 ft. span. Address Box 93, AMERICAN MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W. Detroit, Mich.

For Sale—Machinist's bench lathe, with screw-cutting, milling, gear-cutting, grinding and all other attachments, chucks, tools, etc. ; also a lot of bench tools, drills, reamers, gages, etc. ; all brand new and dirt cheap. F. Jos. Lamb, 20 Central ave., Grand Rapids, Mich.

For Sale, Cheap—Warner & Swasey screw machine, 1⅞ hole in spindle, used about six months ; chuck takes full size ; two cut-off attachments ; one Stowe flexible drill ; two cast-iron tanks, 44 in. long, 34 in. wide, 30 in. deep, ⅝ in. thick. Bettys & Mabbett Co., Rochester, N. Y.

We are open to treat with a large engineering firm or syndicate in U. S. A. for the supply of a complete modern plant for making fuel economizers in U. S. A., the same as made in England ; we have had 30 years' experience in working and manufacturing fuel economizers of all types ; output in England about 300,000 pipes per annum ; inspection at our works if required. Apply Roberts Brothers, Fuel Economizers and Machine Tool Makers, Dukinfield, Manchester, England.

Wants.

Situation and Help Adevtisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded ; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Mechanical draftsman wishes position. Address Box 121, AMERICAN MACHINIST.

Tool, jig, die maker and foreman wants work. Box 110, AMERICAN MACHINIST.

Wanted—Mechanical drawing, out of office hours ; reference. Box 361, Bowling Green, O.

Technical graduate, mechanical draftsman, wishes position. Box 115, AMER. MACHINIST.

Designer and draftsman, expert ; special machinery, tools, inventions. Draftsman, 433 Dekalb ave., Brooklyn, N. Y.

Tool and die maker, with best of references, wants to take charge of manufacturing business. Box 108, AMERICAN MACHINIST.

Expert designer automatic machinery ; shop experience and technical education ; New York or vicinity preferred. Box 104, AMER. MACH.

A young practical mechanical engineer, with extensive experience, wishes position with large manufacturing company. Box 26, A. M.

Practical mechanical draftsman wishes position immediately ; experience on hoisting and mining machinery. Box 107, AM. MACH.

Wanted—Situation by foreman machinist ; 12 years' experience ; up to date in modern methods, estimates and piece work. Box 109, AMERICAN MACHINIST.

Graduate mechanical engineer desires position ; 3 years' experience, steam plants, structural steel, conveyors and elevators. Box 117, AMERICAN MACHINIST.

Draftsman, experienced in small engine and jig work, at present employed in large engineering works, desires position in automobile factory ; can handle men. K. Z., AM. MACH.

Assistant superintendent, technical graduate, 5 years' experience, desires change ; references from present employers ; Rochester, Buffalo or Cleveland preferred. B. R., AM. MACH.

Wanted—Position as machine-shop foreman, well up in all its branches, engines, pumps, compressors, ice machines, machine tools, special devices and jigs. Box 105, A. M.

Machine tool salesman is open to engage with first-class house ; experience, 5 years as salesman and 15 years manufacturing ; first-class reference. Box 103, AMER. MACHINIST.

Technical graduate (26), 2 years' practical experience in machine shop and 1 year in office, desires position as salesman with, or in office of, a manufacturing concern. Box 102, AMERICAN MACHINIST.

Wanted—Position as foreman in machine shop, by a thorough, practical mechanic ; up to date in modern shop methods, and can handle men successfully. Address Box 116, AMERICAN MACHINIST.

First-class man wants position as office manager or accountant ; is experienced accountant, expert in modern shop cost system, good organizer and methodical. Address Williams, Box 119, AMERICAN MACHINIST.

A thorough, up-to-date machinist, of practical inventive ability, well experienced, good tool and die maker, systematic, used to take charge, wants suitable position to make full use of his ability. Box 106, AMER. MACH.

A mechanical draftsman having years of experience, who can take pencil and paper and design Corliss engines or special machinery, who will also look after a few men and see work through the shop, desires a position with a good salary. Address Box 111, AM. M.

A thorough mechanic, technically educated, with extensive mechanical and executive experience, seeks position as mechanical superintendent or chief draftsman with live concern ; engines, machine tools and general machinery ; place with opportunity for development desired. Box 120, AMER. MACHINIST.

As superintendent ; 15 years with the Elgin Watch Co., 5 years with the Springfield Watch Co., 5 years with typewriter company ; as an applicant for superintendent, I wish to correspond with a large company manufacturing light interchangeable machinery, who want the best American methods. Box 118, AM. M.

Engineer desires position February 1 ; highest grade ; immense experience, many lines ; began at bottom, now chief engineer, business million a year ; sheet metal machinery, special machinery, gas engines ; naval architecture, engines ; authority submarine boats, torpedoes ; wide acquaintance ; exceptional executive ability ; a pusher ; correspondence desired. T., care AMERICAN MACHINIST.

(*Continued from page 47.*)

A building to cost about $20,000 will be erected for the Interstate Foundry Company, at Cleveland, O.

A two-story addition, 33x60 feet, will be made to the factory of the Pontiac (Mich.) Buggy Company.

The Western Machine & Tool Company, Grand Haven, Mich., is to put up a machine shop and foundry.

A permit has been granted to Henry Ulrich for a machine shop on Braddock street, near Irwin avenue, Allegheny, Pa.

The Standard Paint Company, of New York and Bound Brook, N. J., is making preparations to build a reduction house.

A building permit has been granted for a factory of R. D. Sheppard, at 51-55 Jefferson street, Chicago, at a cost of $40,000.

C. F. Worman & Co. have taken out a permit for new glass works on Sixteenth street, near Sumner avenue, Allentown, Pa.

The Forest City Foundry & Machine Company, Cleveland, O., is believed to be preparing to erect important new buildings.

The Lange Manufacturing Company, Milwaukee, Wis., manufacturer of office fittings, etc., is erecting a new factory building.

Mayor Depinet, of Erie, Pa., has purchased a tract of land on the Lake Shore Railroad, and at once will erect a stove foundry.

The Millvale Gas Company, Millvale, N. J., is having drawings made for an addition to its works to be erected the coming spring.

Scholze Bros. & Co., Chattanooga, Tenn., have awarded the contract for the erection of a $25,000 soap factory building at St. Elmo.

Adam Jacoby & Brother, manufacturers of furniture, of North George street, York, Pa., are enlarging their factory by a new building.

The Friedman Brothers Shoe Company will erect a factory at Jefferson avenue and Madison street, St. Louis, Mo., to cost about $100,000.

The Buda Foundry & Manufacturing Company, maker of hand cars, etc., Harvey, Ill., will erect a 100x200-foot building, to cost $20,000.

The American Steel Tool Company, Chicago, employing 400 men at its plant there, is negotiating to locate equally large works at Pottsville, Pa.

The Pickering Manufacturing Company, Lowell, Mass., manufacturer of underwear, is considering enlargements, including a dye-house and a yarn mill.

Ehrhart & Plant, whose paint and varnish factory at Jamestown, Mercer County, Pa., was totally destroyed by fire, will erect a larger plant in its stead.

An $8,000 factory building, 50x100 feet, will be erected on High street, west of Nash street, Philadelphia, Pa., for Harlan Page, maker of manufacturers' supplies.

A handle factory in Charleston, W. Va., belonging to the Jennings Manufacturing Company, of Newcastle, Ind., was recently destroyed by fire and probably will be rebuilt.

The new shops to be erected for the Pencoyd Iron Works (of the American Bridge Company) at Wissahocken, Pa., will include a foundry and machine shop, each 100x340 feet.

Contractors Ryan & Kelley, Broad and Market streets, Philadelphia, Pa., are asking bids for the new city water works, to be erected at Roxborough. The cost will be about $25,000.

The Vineland (N. J.) Flint Glass Manufacturing Company is increasing its force of blowers and preparing to enlarge the plant, owing to the receipt of orders for thermometer tubes.

(*Continued on page 49.*)

Help Wanted.

Foreman wanted for machine shop; state age, experience and salary. Box 114, AM. M.

Several good machinists for machine shop in city of Western New York. Address Box 113, AMERICAN MACHINIST.

Wanted—Three first-class die-makers, familiar with blanking, drawing and forming dies. Box 101, AMERICAN MACHINIST.

Wanted—Diemakers; steady employment; state experience and wages wanted. Address The Ohio Brass Company, Mansfield, Ohio.

Wanted—Draftsman on air compressors and gas engines; state experience, age, nationality and salary expected. Box 86, AM. MACH.

Wanted—Competent foreman to take charge of toolroom on sheet-metal dies; must have had experience as a foreman. Box 100, AMERICAN MACHINIST.

Wanted—First-class draftsmen on switchboard work. Address, giving age, experience and reference, W. O. Wakefield, care General Electric Co., Schenectady, N. Y.

Wanted—Draftsman for engine-building establishment vicinity of Pittsburgh; state age and experience and give references. Address Box 97, AMERICAN MACHINIST.

Wanted—Machinist gang foreman for erecting room; must be capable of handling 15 to 20 men; state age, experience and where obtained. Address Box 98, care AMER. MACH.

Wanted—One good mold maker for general repair work on molds; steady work and good wages guaranteed; non-union man only need apply. Address H., care AMER. MACHINIST.

Wanted—At once, two competent men for general machine work, also two experienced men on embossing dies. Apply immediately, Greenwood Bros. & Co., Gardner, Mass., Sta. A.

Wanted—A draftsman familiar with the designing of heavy machine tools, a man competent to take charge of the drafting room. Apply at once to the Grant Tool Co., of Franklin, Pa.

Wanted—First-class machine shop foreman; one with experience in pipe work preferred; state age, experience, references and salary expected. Address Box 91, Terminal Station, St. Louis, Mo.

Wanted—A first-class, all-round practical machinist, to take charge of small machine shop in California; good wages and steady employment to right party; state age, references, etc. Address Box 91, AMER. MACH.

Wanted—A first-class superintendent for boiler shop; must be competent to make estimates, handle men to good advantage and systematize work. Address, giving experience, age and salary required, Box 85, AM. MACH.

Wish to engage the services of competent machine works foreman, capable of handling 150 mechanics to best advantage as to quality and quantity of output; location, suburbs of Philadelphia. Address "Penn," care A. MACH.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Positions furnished for mechanical engineers, draftsmen, etc.; terms, registration fee $1 and 10 per cent. of two months' salary; all reasonable efforts used to secure situations for applicants, but nothing guaranteed; write for full particulars. Technical Agency, Newton, Mass.

Wanted—Superintendent of factory employing 30 to 50 hands in construction of steam specialties; must have had experience in valve work and be up to date in modern shop practice; permanent position to competent man; state experience and salary expected. Address Box 96, AMERICAN MACHINIST.

Wanted—Experienced, intelligent machine-shop foreman to take entire charge of machine shop employing 80 men on high-class heavy tool work and medium-sized special machinery; will have assistant foreman; good salary and future for capable man. Address Box 99, AMERICAN MACHINIST, stating age, experience, references and salary expected.

Dynamo Construction.—We are looking for a practical, thoroughly experienced dynamo constructor, familiar with American constructions, who must be perfect on Gleichstrom and tramway machines; same would be subordinated directly to the technical director of our company, from whom he would receive his orders; applicants for this position will please give information regarding their personality, instruction, where employed, and send also their references and copies of testimonials. Elektrizitaets Gesellschaft Alioth, Muenchenstein-Basel, Switzerland.

A firm of Merchant Engineers in Glasgow having extensive show rooms and special facilities for distribution, will be glad to take up a few additional agencies for mechanical specialties. Send particulars to

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A man of tact thoroughly acquainted with shop practice on heavy machine tools, able to note irrational work and to originate paying methods and appliances. A knowledge of German would be a decided advantage. Urge claims to position in full to

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